SCIENCE LIBRARY APR 18 1921

McGraw-Hill Company, Inc. | A Weekly Journal of the Mining and Mineral Industries | Price 25 Cents Per Copy

ENGINEERING AND MINING JOURNAL

Largest Circulation of Any Mining and Metal Journal in the World

April 16, 1921

Some Aspects of the Zinc Situation

By W. F. Boericke

What Is the Ideal Drill Steel?

By Frank H. Kingdon

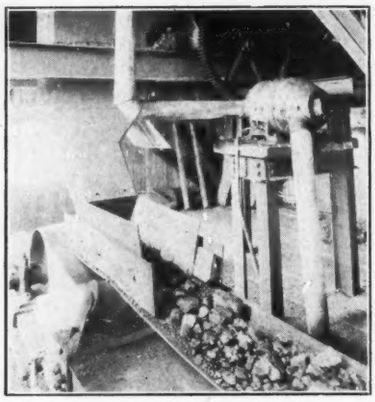
Early Steam Mining in Peru

By W. B. Paley

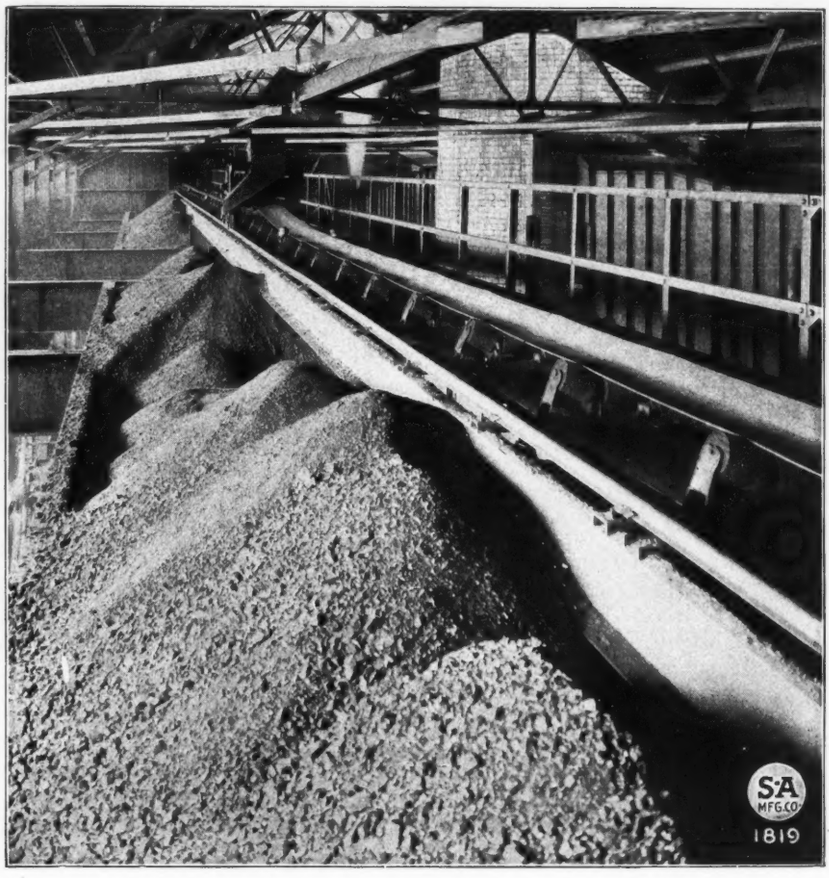
Rand Results in 1920

By A. Cooper Key

Washing Sapphires From Gravel in Queensland, Australia (*See Mining News*)



S-A Belt Conveyors



S-A Belt Conveyors Are Economical to Operate

Conveyors equipped with S-A Unit Ball Bearing Carriers are never extravagant in their power requirements. Actual tests have demonstrated that conveyors, Unit Carrier equipped, require one-third less power than those furnished with other types of idlers.

Don't permit the purchase price to govern your selection of belt conveyors; consider lubrication costs—belt wear—power consumption and service life.

Buy your machinery on this basis and your choice will logically be S-A equipment.

We Also Build

Feeders
Pan Conveyors
Bucket Elevators
Screens
Skip Hoists
Car Pullers
Friction Hoists
Coal Crushers
Portable Conveyors

SEND FOR CATALOG

AURORA S-A MFG. CO. ILLINOIS

STEPHENS-ADAMSON MFG. CO.

AURORA, ILLINOIS

J. E. SPURR
Editor
G. J. YOUNG
Western Editor
D. E. A. CHARLTON
Managing Editor
A. H. HUBBELL
News Editor
E. H. ROBIE
Metallurgical Editor

Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

F. E. WORMSER
W. N. P. REED
CLEVELAND ABBE, Jr.
Assistant Editors
BENJAMIN L. MILLER
J. VOLNEY LEWIS
Special
Consulting Editors

Volume 111 New York, April 16, 1921 *Number* 16

The World Petroleum Problem

THE PROBLEM of the world's petroleum, especially as between the two chiefly interested parties, the United States and Great Britain, is approaching that stage most dear to the American heart, a show-down. It has happily progressed out of the realms of secret diplomacy and open propaganda. The plain note of Secretary Colby has brought back one equally plain from Lord Curzon, British Secretary for Foreign Affairs. Lord Curzon's reply is distinctly polemic. The "partition of petroleum" in Mesopotamia, between England and France at San Remo, he construes as really based on private property rights, in the concessions granted to British interests before the war, and, therefore, inferentially not to be claimed by the United States as a matter for national discussion. Secretary Hughes, however, will not find it difficult to point out that if it had not been pre-eminently a matter for national discussion, in which so-called "private interests" were submerged, it would not have been the subject for debate and barter between the British and French governments at San Remo, and that, therefore, the United States might properly request to join in the conference. Nor will he forget that the "British interests" spoken of were obtained and frankly controlled by the British government.

More to the point appear to be the countercharges of Lord Curzon in respect to certain territories controlled by the United States. He states that the Philippine Legislature in 1920 reserved the development of public mineral lands there to citizens of the United States and the Philippines. Though it is easy to perceive the Japanese (not the British) problem in this Philippine situation, the rejoinder is a fair come-back for American criticism of a similar attitude against aliens in Trinidad, Burmah, the Dutch East Indies, and many other colonies where petroleum is controlled by Great Britain. Also to the point is the charge that the United States has taken means to prevent the exploitation of mineral resources by British interests in Hayti and Costa Rica.

The argument which Lord Curzon makes, however, that America leads the world in petroleum production, is not a sound one, as her petroleum experts can tell him. America's production is greatest because it is being most actively exploited, by Americans, British, Dutch, and others, and, therefore, will be soonest exhausted. The real petroleum problem, as he ought to know, is the securing of petroleum reserves in hitherto undeveloped lands: the problem is not one of last year, or the year before, but of ten years, thirty years from now. By that time, as American and British petroleum experts (and their respective governments) know, the American reserves will have been practically exhausted.

A nation is a continuing organization, and runs its business with an eye to the future, not of the past. Lord Curzon should know, what the rest of us know, that the British petroleum policy is a deliberately worked out plan for world dominion of petroleum, quite in keeping with the British tradition of constantly extending the empire's boundaries: a plan which, it is true, started before the war, and which was constantly pursued during the war and in treaties and agreements since the war.

The American Government, on the other hand, has had no petroleum policy until the plain trend and import of that of England and France made it clear that it was a matter of national necessity to nationally investigate and participate in these far-reaching problems, which were being disposed of in the same cavalier fashion as that in which the German island of Yap was grabbed by Japan. "Every one for himself, and the devil take the hindmost" has been the motto displayed by Europe and Asia to America, ever since those soul-stirring days when we fought shoulder to shoulder for civilization.

We believe the new Administration will bring about a new era of better understanding and fairness. There is no national or international question more important than the question of the world's petroleum. The action of the British and French governments shows that the allocation of the reserves of this most important of all natural resources is a proper subject for national agreement. The action of our Government in asking for a place in the international petroleum council is modest and absolutely necessary.

Foreign diplomats (who are probably hardly fair representatives of their peoples) must forget at once and finally their attitude that the United States is to be disregarded in post-war settlements. The note of Secretary Hughes to Japan, Great Britain, France, and Italy makes this unassailably clear and definite. The equitable settlement between governments of this problem of the world's petroleum will go as far toward banding the nations together and insuring peace as any one thing can do. Let the plain talk go on, because it is plain talk that leads to a clearing of the atmosphere and to satisfactory conclusions.

Improving Drill Steels

"A CHAIN is no stronger than its weakest link," and such a condition may be regarded as quite applicable to drill steel. Comparative figures have brought out the fact that the number of breakages in drill steel is large, but it would appear that a certain percentage of failure is to be taken as a matter of course. Considering the different processes of manu-

facture and preparation of drill steel, there does not seem to be any one stage which consistently produces failure. In some instances the latter may be attributed to the composition of the steel itself, to the heat treatment during and after the forging process, or to the development of stresses in service, or perhaps to a combination of these three factors. It is generally agreed that proper heat treatment is essential, however, and is the most important of these. Steels of various combinations and of different shapes are submitted to different heat treatments, but to be of the greatest service—in other words, to produce the least percentage of failures—each step in the preparation of the steel for the work it is to do in the mine must be performed with exactitude and with a consideration of its specific function.

In this issue we present a paper by Frank H. Kingdon which was read at one of the drill steel sessions of the February meeting of the A. I. M. E. Dealing ostensibly with the essentials of an ideal drill steel, the paper serves as an excellent guide as to what may be expected of the steel maker and the user. Forming, as it does, an important part of mine operation, it is certain that the subject of drill steel will receive close attention from mine managers and be given consideration from many angles. The movement to instigate such research work and make a thorough correlation of the results will ultimately lead to conclusions that will be of lasting benefit to the industry, and we take this opportunity of commending those who have been instrumental in initiating such a study and adding it to the effective program which forms such an essential part of the Institute's activities.

Advice to the Ambitious

WHAT makes this country great is the average greater enlightenment of its citizens as compared with those of other countries; and the average greater freedom from the burden of accepted and dogmatic views, inherited or prescribed. That leaves us at liberty to reason; and the abundant opportunities of the public schools and the multitudinous colleges and special higher institutions bring out the reasoning power. Our daily and weekly press, more widely read in this country than in any other in the world, raises constantly the keenness and the general knowledge of the average mind, and tends to put it above childish passions, prejudices, and errors. Such a preparation and such tangible results in the average breadth of comprehension kept us freer from Bolshevism and the attempted murder of civilization than any other country, pending the practical demonstration in Russia of its childishness.

There is no limit to what you can learn, or the part you can play. There are at least two new Senators in Washington that we know of, and there is one Cabinet member, who have pounded a drill and handled the muckstick in their time. One, we believe, had studied law before the event, and one after the event; and one, we are glad to say, never studied law at all. The whole schooling of that one was limited; but he studied mines and men, and we have no doubt he will be a good judge of laws.

Therefore, ambitious and forward-looking miner or mining man, actually or hopefully, the sky is the limit; it's up to you. The first thing is to learn all you can about your own business. You will learn most of that from the mines themselves if you move around, observe, and ponder: but it is good to have a background of principles and learn what has been done in the past. If you can figure it out, and have not already done so, go to a mining school and take the course. What mining school? The best you can find out about. You should have had, if possible, some practical experience in mining before you go. Pitch in when you get there, and get the meat out of your studies and the experience out of your teachers. There are men who attend college who should be kicked out, because they skim along and waste their time. A lot of them *are* kicked out, but in some colleges at least there are some who are sly or supple enough to loaf along and get their degree and still be small credit to themselves or the mining industry.

When you have got all the mining school offers, get back into the harness, work, experience, and study mines, mills, and the background of the mining industry. Then narrow and concentrate your efforts: as you have hitherto worked broadly, now dig deep. Work for experience, not salary. Above all, be honorable, kind, and human. If you follow out the above we can guarantee your success. What is success? To have a mind at peace, and to love mankind, and to sense the Universal Laws.

Everybody cannot follow out this course of college training. You may find it impossible to travel far and study at what you think the best mining school. If that is so, take the best you can, and, if need be, the handiest, which may well be good. If you cannot study six years, or five, or four, take two or three, or even one year. Possibly—rarely—you cannot take any. You may have a family on your hands, which is a great and fine thing, or otherwise have dependents to support, and find it impossible to lay off and study.

No need to feel discouraged in these days and in this country. Take a correspondence school course, or a university extension course (such as are being given by many schools), or even a summer course. There are men who have hacked their way up without even that. Buy books and study; and at the same time study men and mines, and cultivate the greatest gift of all—horse sense. Books are simply the record of common sense; science and mining are nothing else. It is easy to find men with one or many degrees who are of no use: long memorizing has failed as a substitute for balance of thought, observation, and judgment. The man who knows nothing of books and the man who knows nothing but books are alike ignorant, and bound to be the underlings in the world's struggle onward and upward.

Be modest—you have every reason to be. If you are a college graduate, do not swell up on that account. We remember one college graduate who was shocked because he could not hold a job. "Why," he said, "they don't seem to realize what a Ph.D. from Harvard means." "It means," was the reply, "that you've got to make good, or get fired."

On the other hand, if you have been denied the advantages of school and college, do not try to compensate for it by self-conceit. Do not tell yourself and the world that you are in the same class with Abraham Lincoln, Thomas A. Edison, and the rest. The chances are ten million to one that you are not—that you are an ordinary dub like the rest of us, and need all the help you can get to raise you out of the ordinary, or possibly from the infraordinary up into the ordinary.

That most wonderful of natural forces, the Human Will, is the sword with which you can cut through all

obstacles, overcome all handicaps. It will enable you to overcome the handicap of too soft an early life, and the fatal tendencies of the loafer and the cad; it will smash through the handicap of too rude a beginning, and the danger of becoming a sulker and an ignorant braggart. It is a force which each of us possesses: it grows with use, and can raise any of us so that we can look level into the eyes of any man on earth. And it makes us all good miners. We do not all want to be engineers. In our army we must not dream of having all colonels, as in the standing army of Nicaragua. We need some lieutenants, supply sergeants, and a lot of red-headed, two-fisted, intelligent doughboys. And above the mining engineer comes the general, who directs the lot.

In this country we used to be liberal with our titles. We remember groups where every man was a doctor, judge, colonel, and the rest; and all of them complimentary, and indicative of the desire of friends to please. At the present time it is good form to call anybody that has distinguished himself in science, industry, or education "Doctor." It is largely a kindly, almost quizzical form of address, and indicative of the equality of Americanism. If you cannot honestly earn a doctor's degree in a college, some friendly university may give you one for nothing: but if that fails, you can always depend on your friends.

But as to engineers—mining engineers—that is a little more serious. We should be more careful how we apply the term. "Your husband is a mining engineer?" was the remark once made to a lady we know. "I only met a mining engineer once: he got twenty-five dollars out of me for mining stock. I've had enough." A case of wrong classification, of course; the man she had met should be called a "human engineer." And remember that many a foreman is more fit to handle a mine than many an engineer.

Clay Industry in California

THE CALIFORNIA State Mining Bureau recently issued a preliminary bulletin upon the status of the clay industry in California. From it we gather that since 1887 there has been a gradual growth in the industry, the peak being reached in 1909, with a total production of crude pottery clay of 299,424 tons, valued at $465,647. In 1918, the latest figures available, production was 112,423 tons, valued at $166,788. The value of pottery clay products in 1918 amounted to $1,687,902, and the brick and tile production for the same year totaled $2,363,481.

As nearly as can be ascertained, the producing companies at this time number fifty-two; twenty-three making common brick, five terra cotta, three porcelain and china, five pressed brick, four firebrick and refractory, nine pottery and sewer pipe, two tile, one art pottery, and nine clay. A surprising variety of products is put up on the market—paving brick, common brick, paving fiber, partition tile, hollow building blocks, vitrified sewer pipe, drain tile, flue lining, terra-cotta products, miscellaneous pottery, glazed art pottery, sanitary porcelain ware, chemical stoneware, building tile, Larsite floating brick and porcelain and china products, firebrick, and refractories.

As might be supposed, there are many deposits of clay in California, some developed and being used and others only partly developed. Probably many undiscovered deposits exist. The industry, although not as large as that in the Eastern states, is, however, substantial, and may be expected to develop steadily with the growth of population on the Pacific Coast. The clay industry is intimately related to the growth of cities, as many of its products are used in building construction and for decorative purposes. At present there is a decided increase in building operations upon the Pacific Coast, and the result will be to stimulate considerably this industry, which has suffered from the effects of the war period more than most others have.

Government Scribbling Paper

TO CRITICISE the Government is the favorite prerogative of the governed. It is easier than to work for a better government, and it brings the criticizer more into the limelight, particularly if his style is sufficiently satirical. A favorite opening is afforded by the practice of the United States Government bureaus in sending printed and mimeographed bulletins to those to whom they think the information therein contained will be valuable. In many instances, however, such matter is merely thrown in the consignee's favorite file—the waste basket—unless, perchance, one side of the paper is left blank, when a partially developed sense of economy suggests its use for scribbling purposes. We have devised a better scheme.

Until recently, we received regularly in this office, among other useless things (to us), reports of legal decisions made by the Interstate Commerce Commission, and certain publications of the U. S. Weather Bureau. For the sake of economy, we were willing to invest two 2-cent stamps to carry a message to each of these departments suggesting that our name be deleted from their mailing lists. In reply we received two courteous letters thanking us for bringing the matter to their attention and expressing regret that the publications had been sent where they were not needed.

Those who publish information know that if they wait for some one to clamor for their product, in nine cases out of ten they will wait in vain. Government bureaus, in particular, are expected to give general distribution to their bulletins without waiting for individual requests. The recipients usually find the information thereby obtained more or less valuable. Appreciations are few, but howls are loud if a service is discontinued. We believe that if anyone receives Government publications which are of no use to him, he is open to severe censure for connivance in the misappropriation of Federal funds!

Gold Mining on the Mend

A GRADUAL TREND of the gold industry away from the depression of the last few years is being noted with the fall in prices of supplies and the greater efficiency and supply of labor. Producers of this metal, of course, are elated rather than depressed over the collapse of prices and general industrial depression, for they have much to gain and nothing to lose. South African statistics just to hand show an improvement there, too. The production of the Witwatersrand area declined every month from last August up to January of this year, when a turn upward came, the January production being 31,000 oz. greater than that in December. Foreign producers, of course, where free export of gold is permitted, obtain a premium over the fixed price obtainable in this country by reason of the premium on dollar exchange.

WHAT OTHERS THINK

A Gram of Radium for Mme. Curie

In your issue of March 19 you have an editorial under the subject "A Gram of Radium for Mme. Curie." So little does the public know about radium other than through hearsay that it is perhaps not surprising some of the general information in your editorial is in error. Quite a few articles have appeared of late in newspapers and magazines which leave the same impressions, but the information furnished in *Engineering and Mining Journal* being for technical men, you no doubt wish it to be above the average in accuracy.

There is no real scarcity of radium; the companies producing it have met the demand as fast as it has grown. It may not be unreasonable to think that Providence may have intended that mankind should have to work hard to get anything so wonderful as radium; worth while things are difficult of attainment.

Radium is distributed quite generally over the world, being found in Europe, Australia, Africa, and America, and it doubtless exists in many other countries waiting for discovery. In America, so far it has been found in Colorado, Utah, Wyoming, New Mexico, Pennsylvania, Canada, and it no doubt exists in many other localities. The visible supply of the ores that yield radium is not small in relation to the radium which has been produced and the needs of mankind as so far indicated. The Colorado deposits are now rather thoroughly investigated in particular, and there is no probability of exhaustion of these deposits alone for ten times the half dozen years mentioned in the editorial, and the production of radium is likely to keep step with the progress of mankind in learning to use it. If radium were as plentiful as the more ordinary elements, who knows but mankind might be destroyed before learning how to control and use it?

Radium exists in ores only in such slight traces as not to be considered in percentage, but it must be identified, measured, and controlled by means of electroscope measurements of its radio-activity. The mining, extracting, and recovering of this element is costly far beyond anything ever attempted in a mining and metallurgical way, and is perhaps the most complex metallurgical undertaking ever attempted. It requires approximately six months to extract and finish radium ready for use, after the ore is mined.

From the above it may be inferred that radium is more costly than anything else known to mankind, not because it does not exist in reasonable amounts (considering that it is radium, not table salt, nor pig iron), but because it costs so much to recover it from the condition in which Providence has furnished it, and perhaps as a fitting reward for a hard fight.

The amount of radium used for luminous paints is practically negligible, contrary to so much that has been published of late by those who are not informed, and is a very small percentage of the radium produced. These paints are luminous zinc sulphide with the faintest trace of radium present to keep the zinc sulphide luminous when radium is used, as the price must evidence, but a large part of such paints are being produced by using mesothorium instead of radium. It can, I believe, be stated with assurance that such radium as has been used in luminous paint never kept doctors from obtaining needed radium, but there was a time during the war that the use of radium in luminous paints for the Government saved many lives and materially aided in keeping radium companies in operation.

The production of radium has kept abreast of medical requirements, and the various radium companies of America alone have a combined capacity of at least three grams of radium element per month. There is no danger of exhaustion of radium ore deposits for many years to come, and all demands for radium have been promptly met by the companies producing it.

L. F. VOGT,
Canonsburg, Pa. Standard Chemical Co.

Principles of Copper Leaching and Precipitation

A number of statements are made by Frank E. Lathe, in the paper on the principles of copper leaching and precipitation practice, presented at the recent meeting of the Canadian Institute of Mining and Metallurgy, as reported in the March 12 issue of the *Engineering and Mining Journal*, as to which opinions will differ. It is stated that crushing must be sufficiently fine to set free the copper mineral, and thus make a good extraction. As I understand the term "setting free a mineral," this is usually understood, in describing milling practice, to mean that, in an ore so crushed, the individual particles of mineral are practically free from gangue. I do not know of any crushing being done for leaching so fine as this, and the main object of crushing in this instance is to permit access of solution to the mineral and its removal by washing in a reasonable time, an entirely different matter, which has little to do with "setting free the mineral" in the ordinary acceptation of that term.

In the paragraph following we read that "copper sulphides are almost insoluble in ordinary leaching solutions, whereas those of iron are often fairly soluble." I would be inclined to doubt any appreciable solubility of iron sulphides in "ordinary leaching solutions."

Regarding the advantages and disadvantages of sulphuric acid as a solvent, although it is true, as Mr. Lathe states, that some oxides of iron and aluminum are dissolved by it, the main objection to this comes from an increased acid consumption and not from "fouling the solutions." Foul solutions, in practice, have proved to be much less of a bugbear than they are in the literature of copper leaching, and it is a fact that copper electrolysis, as carried on at Ajo, could not be done with pure solutions of copper sulphate.

The statement is made regarding ammonium compounds that they cannot be regenerated by electrolysis. Although this has not been done practically, I am not at all sure that it cannot be accomplished, and some work has been done on this problem. In my opinion it is a proper field for experiment, which may result in a method at least as cheap and practicable as the present process of recovery.

Mr. Lathe states that reduced ferric salts are hard to oxidize, and that precipitation by electrolysis is impossible. The latter is, of course, true if ferric salts are present in large amounts in an electrolyte, but I do not believe that it will be found impossible to work out an electrolytic method making use of the solvent action of ferric salts. Such a method, although it would probably have a restricted use for special operations only, would nevertheless have the great advantage of being able to dissolve sulphides of copper without roasting.

As to what is said regarding upward and downward percolation, so far as I am able to judge from what is told me by competent metallurgists familiar with both the Ajo and Chuquicamata plants, there are no obvious advantages from the choice of either method. I would hesitate to say that upward percolation necessarily results in more rapid extraction or in ten times as much water-soluble copper in the tailings, as stated by Mr. Lathe.

In comparing consumption of acid at different plants on different ores, the number of pounds consumed per ton of ore signifies little, and it would be more informing to state the consumption in pounds of acid per ton of copper extracted.

The author does not give the whole story in the statements that he makes with respect to graphite anodes. It is true, as he says, that liberated oxygen and ferric salts attack graphite, and that is true for lead, which is not so stated by him, but this attack on either lead or graphite is only true for solutions of pure copper sulphate or those which do not carry sufficient depolarizing agents. Without the presence in solution of depolarizing agents, neither graphite nor lead could be used as anodes, as the first would be disintegrated and the second peroxidized by the oxygen evolved; but the evolution of free oxygen is prevented by the presence in solution of sufficient depolarizing agents (SO_2, ferrous sulphate or both), and either graphite or lead anodes are entirely durable under these conditions. This fact was the most important practical discovery made during the course of large-scale leaching experiments for the Phelps Dodge Corporation, under my direction, and this method of preventing the disintegration of anodes, which was not known previously, is covered by patent. I am informed that graphite is in use at a plant in Australia with perfectly satisfactory results, and the lead anodes at Ajo are certainly durable, and the durability of both are due to the facts above stated.

The statement made by Mr. Lathe that the amount of copper deposited per kilowatt hour should be 0.7 to 0.9 lb. is conservative. As a matter of fact, it should be much more than this, and tests have shown that much higher yields are entirely practicable. Of course, local conditions will not always make the use of such practice possible, but there is nothing very complicated or difficult in getting a yield of 2.5 to 3 lb. of copper per kilowatt hour.

In the discussion of Mr. Lathe's paper, Mr. Mathewson mentioned the use of large current densities, and although under such conditions the size of the precipitating plant would of course be reduced, it must be borne in mind that neither graphite nor lead anodes can be used with high enough current densities to give evolution of oxygen, as such, at the anodes, as they would rapidly disintegrate under these conditions.

Los Angeles, Cal. G. D. VAN ARSDALE.

The Roads to Knowledge

I have made it a point never to force my opinion on anyone and have cultivated the habit of respecting the opinions of others, in some cases more than I do my own, especially when their positions entitle them to this respect.

I believe the editor in the March 5 issue of *Engineering and Mining Journal*, under the heading, "Only a Correspondence School Engineer," missed one point, and a very important one at that. I submit it, and hope it will be received as intended, kindly.

No one would care, I'm sure, to take issue with the editor when he claims superiority for the university over the correspondence school, else why should students spends thousands of dollars at a university when the same thing could be obtained for a few hundred through a correspondence school? Let us, however, take the case of a young man, John Smith (just any young man), who has a family and an earnest desire for betterment. University training is absolutely out of the question. So he and his life partner plan and save for a correspondence course in mining. He studies faithfully, and by the help of the officials gains experience first in one branch and then in another, as his studies progress, until he becomes quite proficient, and at last obtains a position of enough importance to be considered a credit to the profession, and in a small way a success.

OR—Smith after commencing his studies subscribes for the *Engineering and Mining Journal*, and finds the knowledge to be gained therefrom invaluable. But one evening he reads of a certain man termed "Only a Correspondence School Engineer." Upon reflection and realizing the editor is a man of note and experience, and that his opinion must represent that of his fellow engineers, Smith thinks that if his efforts are considered in this light he might as well say with the rooster "What's the use, anyway? Yesterday an egg and tomorrow a feather duster."

As there are men who have reached the highest rung on the ladder of success without university training, a proper consideration not only for those struggling young correspondence school men but for the mining industry in general should have caused the editor to leave out "Only a Correspondence School Engineer."

No correspondence school man expects an equal chance with a college-trained man, but the correspondence study is not to his discredit; so why speak or write of anyone as "Only a Correspondence School Engineer"?

Sixes, Ore. G. E. MCGINITIE.

Copper Producers Helpless in Matter of Price

We have read with a great deal of interest the editorial in *Engineering and Mining Journal* of Jan. 8, entitled "Why Is Copper a Luxury?" It seems to us that the copper producers are rather helpless in such a situation as you mention, namely that of the copper screens. In the last few years competitive conditions have been set at nought. No doubt manufacturers who did not get as much profit as possible on the market from the luxury screening were called foolish.

Is it not your opinion that in this, as in a great many other items, the only help for the copper producers will come with renewed keen competition between different manufacturers? SECOND WARD SECURITIES CO.,

Milwaukee, Wis. E. M. Keays.

Some Aspects of the Zinc Situation

A Study of Production, Consumption, and Prices During the Last Two Decades Indicates That Present Conditions Can Only Be Temporary and That a Tariff Increase May Not at This Time Be Desirable

BY W. F. BOERICKE
Written for *Engineering and Mining Journal*

"AS A RESULT of the war, the United States has become the leading source for the world's zinc. Belgium and Germany used to supply most of the international demand, but these countries are not now able to produce zinc to compete with the American product."—From an article entitled "Zinc Trade of the World," in the *Commerce Monthly*, published by the National Bank of Commerce of New York, November, 1920.

"The United States production henceforth must be limited to the extent of her own domestic requirements, as her producing cost will not permit of competition with European zinc."—From the November letter of the European correspondent of the American Zinc Institute.

Here are two conflicting statements, emanating from two authorities, each worthy of serious attention, that affect vitally the prosperity of the American zinc industry, which today is looking into the future with no certain discernment. If it be a fact that production costs in Europe will be so high that American zinc can find a profitable market there, the zinc mines and smelters of the United States can look forward to a long era of prosperity and expanding business, during which the phenomenal production of 1916 and 1917 may be equaled or even exceeded. If, on the other hand, production is to be limited strictly to the needs of this country, it is likely that there will be a necessity for curtailing production for some time to come, and business will be on an extremely competitive basis, with prices approximating the cost of production at the best-equipped and most economical plants, until all surplus producers have been forced to the wall or taken over by their more powerful rivals.

To gain a clear conception of the situation, it is necessary to make a careful study of the statistics of the zinc industry of the United States during the last two decades. The following table gives the production, consumption, and surplus of production over consumption (or vice versa) of primary zinc in the United States for each year from 1903 to 1920:

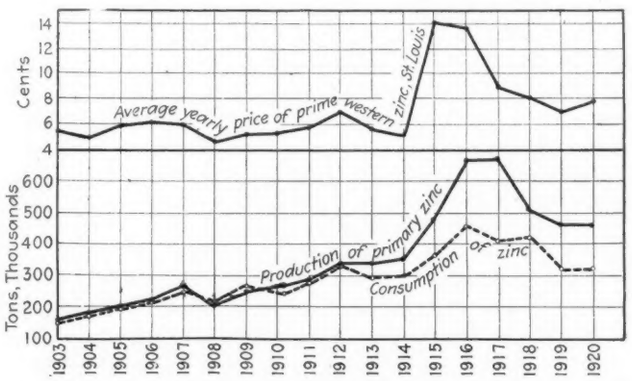
ZINC PRODUCTION AND CONSUMPTION IN THE UNITED STATES
In Short Tons

Year	Production	Consumption	Surplus	Per Cent of Production
1903 (*a*)	159,219	154,381	4,838	3.0
1904 (*a*)	186,702	180,901	5,801	3.1
1905 (*a*)	203,849	200,438	3,451	1.2
1906 (*a*)	224,770	220,781	3,989	1.8
1907 (*a*)	249,860	226,969	22,892	9.1
1908	210,424	214,167	— 3,743	1.8 (*b*)
1909	255,760	270,730	— 14,970	5.8 (*b*)
1910	269,184	245,884	23,300	8.6
1911	286,526	280,059	6,467	2.2
1912	338,806	340,341	— 1,535	0.4 (*b*)
1913	346,676	295,125	51,551	14.8
1914	353,049	299,125	53,924	15.5
1915	489,519	364,855	124,664	25.4
1916	668,343	459,317	209,026	31.2
1917	669,573	413,643	255,930	38.2
1918	517,927	423,792	94,135	18.1
1919	465,743	323,964	141,779	32.5
1920	463,000	324,000	139,000	30.0

(*a*) Includes production of secondary zinc. (*b*) Decline.

The chart gives the same figures in graphic form. The lower solid line depicts the production of zinc, the broken line the consumption, and the top solid line shows the average price of zinc for each year at St. Louis.

The table naturally divides itself into three parts. The first takes in the years 1903-1914 inclusive, a period of normal development of a great industry, marked in general only by the disturbance due to the 1907 panic. The second part, properly starting with the outbreak of the World War in 1914, extends through 1918, with the signing of the armistice, and embraces the immense development of the industry in response to war demands, with the hectic and sensational price advances in the metal. The third, the readjustment era, brings us to



A COMPARISON OF THE PRODUCTION, CONSUMPTION, AND PRICE OF ZINC IN THE UNITED STATES FROM 1903 TO 1920

the present year, and this chapter is far from being closed.

Considering the first period, 1903 to 1914, it is evident from the table that, until 1913, at no time was there any appreciable surplus of zinc for which a large foreign market had to be found. Until 1907 production and consumption nearly balanced. In 1907, a surplus of 22,892 tons, about 9 per cent of the production, accumulated, but this was easily absorbed in the following years, during which consumption exceeded production. In 1910 there was another surplus of 23,300 tons, which was likewise taken up in 1911 and 1912.

In 1913 there was a considerable excess of production over consumption, due not so much to large zinc production as to a considerable drop in consumption. Importations of foreign zinc were made as a result of tariff changes, and stocks accumulated rapidly. The industry was in a depressed condition, more on account of a slowing up of general business than from importations. Then came the war, and with it an entire change in the situation.

DEMAND NOT LESSENED BY HIGH PRICES

During the pre-war period, production increased from 159,219 tons in 1903 to 353,049 in 1914, an increase of 193,830, or 121 per cent. Consumption increased from 154,381 to 299,125 tons, an increase of 144,744 tons, or

94 per cent. The average rate of increase of consumption per year was 13,158 tons, and this figure might be taken as the normal rate of increase in domestic consumption for the industry, representing a healthy, natural growth under normal price conditions. The average price received for zinc during this period was 5.58c., St. Louis.

A study of the chart shows that in general the production curve was more sensitive to price variations than the consumption curve. In other words, there is little evidence that a lower price for zinc stimulated the demand and increased consumption. On the contrary, the largest consumption for the period occurred in 1912, when the price reached its highest figure, 6.93c., and a drop to 5.61c. and 5.11c. in 1913 and 1914, instead of increasing the demand, showed a falling off in consumption. These were years of unsettled business conditions in the United States, due to the change in the administration and to uncertainties in the tariff and financial issues. Demand for zinc decreased, along with general business.

The conditions affecting the industry during the war period are too well known and recent to require more than the briefest résumé. The seizure of the Belgian smelters by the Germans cut off at a single stroke the main source of zinc for the Allied countries. A glance at the following table will show how dependent those countries were on imported zinc, which came in large part from Belgium and Germany.

FOREIGN PRODUCTION AND CONSUMPTION OF ZINC IN 1913

Country	Production, Tons	Consumption, Tons	Excess of Consumption Over Production
Great Britain	73,020	214,508	141,488
France	74,835	89,286	14,451
Italy	.....	12,015	12,015
Total	147,855	315,809	167,954

At the outset of the war, therefore, these countries were confronted with the necessity of finding over 100 per cent more zinc than they produced in order to supply their normal peace-time requirements, in addition to the urgent needs of war material. They turned, of course, to the United States as the most available source of supply. Under the stimulus of competitive bidding, the price of zinc went almost perpendicularly from 5c. to 23c. per lb. Production rose from 346,676 tons in 1913 to 669,573 in 1917, an increase of over 90 per cent. Exports rose from 7,783 in 1913 to 220,064 in 1917.

During the war period consumption increased from 299,125 in 1914 to 423,792 in 1918. The peak was reached in 1916, with a consumption of 459,317 tons. This, for the four-year period, was at the rate of 31,167 tons per year average increase, compared to 13,158 tons per year, the average yearly increase in the eleven-year period before the war. The conclusion is of course unavoidable that this increase in consumption was abnormal and due solely to war demands, and the consumption figures for the third period bear out this conclusion.

Last Two Years Not a Reliable Index

In 1919 and 1920 consumption was practically the same, at the rate of 324,000 tons per year. Neither year gives a satisfactory index of the peace-time requirements of the United States. Nineteen-nineteen, with the wholesale changes attendant to the signing of the armistice, and the sweeping adjustments made necessary in passing from war to peace, gives little guide, and 1920, with its manifold labor difficulties, transportation troubles, price inflation, and final business depression, is quite as unreliable. The consumption for the first six months of 1920 was 175,268 tons, making an indicated consumption of 350,000 tons for the year had this rate been maintained. The difference was, of course, due to the slackened business conditions during the latter part of the year.

Is this consumption, 325,000 to 350,000, a *normal* consumption for the United States? Considering the pre-war consumption figures, a maximum of 340,341 tons in 1912 and 295,125 in 1913 is noted, and 1913 was, as has been recorded, a year of business depression. The normal annual increase in consumption for the pre-war period was about 13,000 tons per year. Were this rate maintained, a normal consumption of approximately 400,000 tons would be indicated as the domestic requirements in 1920. It should be emphasized that this whole amount would be consumed in the regular requirements of industry, considering the normal business requirements and the increase in population, and has nothing whatever to do with the extraordinary demands of war or special exigency. It seems to me that this figure is not far out of reason as a basis on which to work.

Unfortunately, however, in the distorted and extravagant trade tendencies of the war period, there is little means of knowing whether this increase in consumption was actually maintained in the industries dependent on the zinc business. Despite an ardent and persistent advertising campaign for increased use of zinc in industry by a certain large interest, there was undoubtedly some substitution of other metals and materials in certain lines which formerly consumed zinc. This was due in part to war necessity, which made it incumbent upon manufacturers to substitute a cheaper or more available material for that which might be theoretically the best. The greatly decreased use of brass in automobiles, for instance, and a production of some so-called galvanized products which have not lasted as well as the pre-war article, are cases in point. The competition of various forms of roofing has made inroads into the promising field expected, as a result of the century-old success in Europe of zinc roofing. These fields are still open, with immense possibilities, but there is need for the skilled salesman as well as for the miner. On the other hand, numerous new and growing uses have been found for the metal, and particularly for the byproducts.

Production Will Not Be Excessive

Assuming, however, that 400,000 tons per year may reasonably be expected to be consumed in 1921 in the domestic market, what relation will this bear to production?

As has been previously pointed out from the chart, until 1912 production and consumption in the United States practically balanced. In 1913 and 1914 there was a considerable surplus, and the importation of European zinc into this market, due to the elimination of the tariff, would undoubtedly have put a damper on the opening of new sources of supply. It is highly probable that had conditions remained normal there would have been no such expansion of the industry as resulted in the ensuing years.

Between 1914 and 1917 the production of the United States increased over 160 per cent of the entire increase for the preceding eleven-year period. A considerable part of this production was made in quickly constructed, high-cost plants, the output of which was made possible only

by the high price of zinc, and it was a foregone conclusion that the production of these plants would rapidly drop off and ultimately disappear with the return of the price to a saner basis. In considering the *potential* production of the country, therefore, it is absolutely necessary to limit the figure to the possible production under normal price limits, and this figure will be much less with 6 or 7c. zinc than with extravagant figures.

The production in 1919 and 1920 was practically the same, but the *rate* of production decreased rapidly toward the end of 1920. For the first six months the production was 258,108 tons, at the rate of 516,000 per year; for the last half only 206,000, at the rate of 412,000, a decrease of 20 per cent. It was estimated that on Jan. 1 only 52,500 retorts out of a total of 157,000 were in operation, and even this number is said to be decreasing. This would be at the rate of possibly 200,000 to 250,000 tons per year, much below the pre-war figure as far back as 1909.

Rich Ore Deposits of Oklahoma Proved Unexpected Stimulation

With the price of zinc at the end of the year below the average for the 1903 to 1913 period, and smelting costs much higher than in 1913, it is evident that a halt in production was bound to occur. It would have come earlier but for the extraordinary production of zinc in the Oklahoma field. Because of the intensive prospecting in this field during the boom years of 1915, 1916, 1917, stimulated by high ore prices, orebodies were drilled and developed in months which it ordinarily would have taken many years to block out.

It is estimated that an amount of drilling equivalent to ten years' prospecting was done in a third of that time. This fact, added to the amazing richness of some of the orebodies, plus the insecurity that many operators had in the tenure of their leases, and their reluctance to let go even in the face of an overproduction of zinc ore and falling ore prices, caused this district to increase its output 20 per cent over its 1919 production, reaching the record figure of 560,000 tons for the year. Much of this ore was sold for prices below pre-war figures, with costs at least 50 per cent higher than prevailed then. It is even questionable if many of the operators got back a new dollar for an old one, considering operating costs alone, and making no allowance for overhead, amortization, or depletion of orebody. The fact remains, however, by virtue of this vast production of high-grade blende, that the smelters dependent on this ore received an adequate supply, at prices, during part of the year at least, below the cost of production.

Price Affects Producers More Than Consumers

It has already been noted that apparently the zinc consumption curve is not directly affected by the price. In other words, consumption depends more on general business conditions, especially building activity, than on a high or low price for zinc. This point can be appreciated by considering the comparatively small amount that even a large fluctuation in zinc would figure, in relation to labor and other cost, in a large building, for example. Yet its general use would be considerably influenced by the amount of building activity.

Production, however, is affected vitally by the price, and its curve follows price fluctuations much more constantly. Allowance must be made for necessary lag for production to respond to a higher price, and for the momentum that will carry along production at a high figure even after the price has fallen. Taking this fact into consideration, it is illuminating to note the production of the last two years in relation to the price. The figure is about the same for the two years, about 463,000 tons. The average price was 7c. in 1919 and 7.8c. in 1920, but, as noted, the price fell sharply toward the last of the year to a low of 5.5c. Ot 157,000 retorts in the country, 107,500 were in operation on Jan. 1, 1920, and 95,000 on June 30, about two-thirds the capacity. Presumably the rest would be unable to show a profit under existing costs with 7.5c. zinc.

With a drop to 5.5c. at the end of the year, the number of retorts was reduced to 50,000, approximately. The possible production from these would be about 200,000 tons per year. This figure is about two-thirds of the country's pre-war requirements, or about one-half the requirements as calculated in a preceding paragraph. If 400,000 tons per year as the normal requirements of the country is approximately correct, it is evident that this rate of production will fall far short of satisfying the domestic demand. Is it reasonable to believe that this balance of 200,000 tons can be supplied from abroad, at anything like present prices?

To answer this, a consideration of the world statistics of the metal is essential. The pre-war production and consumption of zinc for 1913, which incidentally are the last reliable figures available for the different countries, are:

WORLD PRODUCTION AND CONSUMPTION OF ZINC IN 1913
(In Tons)

Country	Produced	Country	Consumed
United States	346,676	United States	295,370
Germany	312,075	Germany	255,734
Belgium	225,112	Great Britain	214,508
France	74,835	France	89,286
Great Britain	73,020	Belgium	84,216
Netherlands	26,811	Austria	44,533
Austria	21,504	Russia	36,707
Russia	11,574	Italy	12,015
Others	25,810	Netherlands	4,409
		Others	29,541
	1,117,417		1,066,319

In 1913 the United States evidently produced about 30 per cent of the world's zinc, and consumed nearly the same amount. The situation today, owing to the manifold changes politically and economically as a result of the war, is wholly different. Outside of the United States there is not a single country in a condition to approach, much less exceed, pre-war production. Germany and Belgium were, and still are, the mainstays of European production. For 1920 the Belgian production is estimated at 90,000 tons, and that of Germany around 100,000. The world's production, outside of the United States, is estimated at only 280,000 tons. This compares with 770,000 tons in 1913, a decline of over 60 per cent.

European Conditions Remain Deplorable

Large as the decline has been, it is debatable if it is not warranted by the lessened demand for the metal abroad, resulting from the chaotic industrial conditions in Central Europe. It must be kept in mind that a large and expanding demand for zinc can arise only from countries with well-developed industries. There are in addition the enormous difficulties of doing business with countries where all trading is practically on a barter system, with a wildly inflated paper currency and fluctuating exchange rates that tend to make every transaction a gamble. Under one or the other head can be classified many of the most important pre-war consumers of the metal. Russia and Austria, in par-

ticular, which formerly took large amounts of zinc, are now eliminated. On the other hand, consider the growing needs of Japan and Canada, which, by virtue of the development of their industrial system, are rapidly becoming large consumers of zinc.

That a *need* for zinc and zinc products now exists in Europe, especially in the devastated area, where rebuilding must be done on an unprecedented scale, is undoubtedly true. But a sharp distinction must be made between this and *effective demand*, which not only means the mere desire for the commodity, but in addition the power of purchasing. Too often this last eminently practical point is overlooked by enthusiasts who can see only the need for the product. If Russia, Hungary, Poland, Jugo-Slavia, and central Europe generally were able to make an effective demand for zinc, the apparent overproduction of the metal would vanish overnight.

Rehabilitation of the Industry Likely To Proceed With Speed

To believe that this effective demand will be long in awakening is, however, contrary to all precedents of history and economics. The history of all virile nations is full of examples of conditions under which a country decimated in population, burdened with indemnities, and apparently with no hope of regaining trade or prestige has arisen Phoenix-like to a commanding position in an unbelievably short space of time. There is good reason for believing such will be the experience of many of the war-ridden countries of today, especially where the fixed factors of production, land, permanent improvements, and machinery have been unscathed by war.

The present situation in zinc, from an international standpoint, is entirely artificial, as is apparent to those who have studied it, miner and economist alike. It is an unfortunate combination of post-war adjustments, poor trade conditions, and the lowly state of Continental exchange. With the signing of the armistice, the Allied governments found themselves with considerable stocks of zinc on hand, in addition to a vast amount of scrap material reclaimed from the battlefields. The presence of these stocks, like our own sales of surplus war material, acted as a brake on any continued price advance, and will continue to do so until absorbed in industry. Inability of central Europe to buy led to a further slowing up. Finally, there is the curious anomaly of German zinc being sold in London at a price which makes profitable shipment of the metal to the United States and resale here, duty paid, at less than the American cost of production.

How Foreign Exchange Affects Zinc Prices and Markets

The reason, of course, lies in the devious workings of foreign exchange, and is wholly independent of costs of production which would normally govern. With a government-controlled price of coal in Germany, equivalent to about $1.60 per ton, and ore and labor paid for in marks, there is a profit in zinc when sold on the London market for sterling, when the enormous depreciation of the mark is taken into consideration. Even if there were no profit on the transaction, it still might pay the smelters by yielding funds for English purchases, which might be imported into Germany and sold for more than the zinc costs.

Obviously such a trade is only temporary. In the first place, with a production of only 100,000 tons per year, Germany is short 150,000 tons of supplying her own pre-war requirements, which, with any resumption of trade, may be expected to take her entire production for some time. In the second place, this trade is dependent upon the continued depreciation of the German mark, and the willingness of the German workmen to accept a cost of living, or a lowering of his standards, out of all proportion to what he enjoyed before the war. Neither condition is likely to persist.

Obviously, a small rise in the value of the mark today would play havoc with the present trade relationship. Suppose sterling, with marks at 1.50c., is exchangable 260 for 1. Should marks advance even 0.50c., the exchange rate would be cut to 190, and much of the advantage of the German exportation would be lost. Likewise, any relaxing of the price of coal by the government would immediately raise the price more nearly to the level paid by the Belgian and English smelters, and increase proportionately the cost of smelting. Such a demand by rival industries in need of fuel is certainly to be expected with any increase of industrial activity.

It is reasonable to believe, therefore, with the absorption of government stocks and improvement in European exchange, that the London price will rise to the present cost of production of the Belgian smelters, which is reported to be £40 per ton. It is entirely probable that the world-wide drop in commodity and labor costs now in process will further shade the figure, but not to a great extent.

It should be further noted by the American producer that he is afforded an automatic protection through the same medium that has caused his present distress—the operation of foreign exchange. With every 10c. rise in sterling, the price of zinc advances over 0.1c. per lb., the London market remaining unchanged at £25. The following table has been constructed for several prices of zinc and varying exchange rates:

VARIATION OF EQUIVALENT ZINC PRICE WITH STERLING EXCHANGE

London Price of Zinc, per Long Ton	Sterling Exchange	Equivalent Price per Pound, Cents
£25	3.50	3.90
	4.00	4.46
	4.50	5.02
	4.86	5.42
£30	3.50	4.68
	4.00	5.35
	4.50	6.02
	4.86	6.51
£40	3.50	6.25
	4.00	7.14
	4.50	8.03
	4.86	8.68

To this there is to be added, of course, freight, commissions, and the present 15 per cent ad valorem duty.

From a negligible amount of zinc exports in 1910, the United States in 1917 exported over 220,000 tons, 25,000 tons more than Belgium in 1913. In 1920, exports were 114,500 tons, the greater proportion of which were made in the first six months of the year. In view of what has been said in preceding paragraphs, no argument is required to show that this country under normal price conditions will be a large exporter of the metal, to the extent of 100,000 tons. There is a little danger that Europe's production of zinc will exceed its own needs for a considerable time, or until natural trade channels are again reopened and more normal conditions prevail. With an increase in the world's consuming capacity to a point approaching the pre-war figure of 1,000,000 tons per year, the United States will be called upon to make good the deficiency in production.

It may also be noted that under the terms of the reparation payments to be made by Germany, an amount equivalent to 12½ per cent of the value of exports may be levied on that country. This of course will add to the cost of production and amounts to an additional protection to the price of zinc, to the benefit of the American exporter.

Present Conditions Temporary and Upward Revision of Tariff Undesirable

The foregoing, though optimistic for the future, provides only cold reading for the American producer, who sees foreign zinc today in active competition with his own product at the seaboard, at prices below his cost of production. Some contend that the country has now become not an exporter but an importer of zinc. This, except for the moment, is at utter variance with the facts. Now is a time, if ever, to keep a firm grasp of fundamentals, and endeavor to look not at conditions today, but at what they will be a year, and five years, hence.

It cannot be too often emphasized that the present situation is entirely artificial and not due to natural conditions of demand and supply in the industry. A tariff, now being urged by certain interests, would offer temporary relief, but the stopping of imports would simply add to the foreign stocks, weakening the London market still further, and would delay by just so long the resumption of the foreign demand which is relied upon to take up our own surplus. A slump in domestic demand, amounting to an almost complete stagnation momentarily, is the primary cause of the disastrous price drop, not the foreign importations. If the tariff suggested were purchased at the expense of retaliatory tariffs by other countries against American products, such as are now threatened, it might prove to be a boomerang.

The one thing that would probably help the situation as much as anything else would be the resumption of industrial activity in central Europe, and particularly in Germany. Assured of that, there would be little need to worry over a surplus German production for some time. The final settlement of the indemnity, and an early formal peace, both of which are reasonably assured in the near future, will be constructive features of the highest order. With an abundant ore supply, improved labor conditions, and lowered costs, the American producer can look to the future with confidence.

Fixing of Prices by Nitrate Association Of Chile

At a special session of the directorate of the Nitrate Association, held on Jan. 26, 1921, the prices of nitrate for May and June were set at 17s., the figure now ruling for April. The directorate also announced that it would guarantee that the prices for the first ten months of the coming nitrate year—from July 1, 1921, to March 31, 1922—would not be less than 14s. per Spanish quintal (1 quintal = 101.4 lb.). Definite prices will be fixed in May or June of this year.

The maintenance of the present high prices during the last two months of the nitrate year will virtually make impossible any sales by the association for delivery within that period, according to Consul Dana G. Munro, in *Commerce Reports*. The association apparently intends to make no serious effort to effect further sales for the current year. A large part of this year's exports is still unconsumed, and will be left on the hands of the dealers in Europe and the United States. The maintenance of the April price through May and June, and the announcement that the price for the ten months after July 1 would not be less than 14s., was intended to protect the interests of these dealers who have purchased their stocks at the high prices fixed by the association for this year, and also to give the banks financing the purchases definite assurances which would enable them to continue their assistance to the trade.

The decision of the association is on the whole regarded as wise, in view of the close connection between the interests of the producers and those of the large distributors. The disorganization of the market by the sale of nitrate at low prices when there were in existence large stocks purchased at much higher prices would react unfavorably upon the entire industry. On the other hand, the fear has been expressed that the maintenance of comparatively high prices might stimulate the competition of other fertilizers and curtail the consumption of Chilean nitrate. The current price is at least 2s. 6d. below the figure of 14s. announced by the association, but there are no very large quantities on the market.

The probable effect of the association's announcement will be a postponement of the hopes for an improvement in the nitrate market until a considerable part of the large stocks now existing have been moved. It seems improbable that there will be any further sales until the beginning of the coming nitrate year on July 1, and the improvement may be delayed even longer unless business conditions in the United States and Europe improve considerably before that time.

The Problem of Mining Canadian Iron Ores

A federal bounty, to be paid by the Dominion government on iron ores mined in Canada, has been advocated as the best means of developing the large bodies of low-grade ores which exist in that country. The subject came up for discussion at the March meeting of the Canadian Institute. At present, 95 per cent of all the iron ore smelted in Canada is imported from the United States or Newfoundland. G. S. Cowie thought that a bounty of, say, $1 per ton would be the best way of encouraging domestic production. The chief opposition to the plan, he said, came from the West, where it was thought that such a bounty would raise costs of iron products, a false assumption, as the speaker pointed out. This seemed to be the only means of assisting the industry. The Moose Mountain operations have already closed down and the Helen and Magpie mines may follow unless something is done.

Another speaker suggested that, instead of a bounty, a certain sum of money, say $300,000, be set aside for investigational work, which might later be returned. Or some inducement might be given for smelters to use Canadian ore. At present the native ore is unpopular, because most of it is low-grade magnetite, high in silica and sulphur, and in some cases high in phosphorus as well. There is also some siderite, as at the Magpie and Helen, and in Nova Scotia, where the siderite and magnetite are mixed.

Further, it was pointed out that Canadian furnaces had adopted American smelting practice, and it was therefore natural that American ores should be the most desirable. More research work was necessary for the purpose of developing a furnace and formulating a practice which would be suitable for Canadian ores.

Rand Results in 1920

Operators Depending on the Gold Currency Premium—Total Profits Slightly More Than Premium, but Dividends Rather Less—Working Costs 50 per Cent Higher Than Pre-War Figures—Ore Exhaustion and Economic Elimination

BY A. COOPER KEY
Written for *Engineering and Mining Journal*

IN PAST YEARS the association of America with the Rand has been largely a matter of personalities: of engineers and commercial firms. But latterly the connection has been financial. The Rand may be said to be living on the currency premium on gold, the deterioration of the British Treasury note compared with the dollar. What in years past would have been an economic heresy, that gold could command more than 85-per fine ounce, has proved an actual fact. It may be argued by some theorists that there is no such thing as a premium on gold, but, as one of the leaders of the industry said to me over a year ago, "It is all very well to talk like that, but the fact remains we are banking so much extra for our gold." In 1919, the Rand mines did not show this additional revenue in their monthly statements, nor did the Chamber of Mines take credit for it in the monthly output declaration. But the actual arrangement for a free market in gold was brought into being by Messrs. Rothschild & Sons in London in July of that year, and upward of four millions was actually received by way of premium in the final five months of the year.

Fears that the premium would not last doubtless led the companies not to bring it into account each month, and this policy created the anomaly of certain low and medium-grade mines showing losses or modest profits, whereas the addition of the premium revealed handsome profits. Even at a sovereign an ounce, about the average in 1919, but since exceeded, it will be realized that the extra revenue is an enormous benefit to properties like Crown Mines, with an output of 53,000 oz. monthly; Randfontein, with its 30,000 oz.; New Modder with 42,500, and a string of mines with from 15,000 to 30,000 oz. Since January, 1920, gold has been taken at realization price.

PREMIUM EIGHT AND ONE-HALF TO TEN MILLIONS STERLING

The currency price of gold is found by taking the figure $20.67183, the price which the United States Mint pays for fine gold, and dividing by the London-New York exchange. Allowance has to be made for brokerage, insurance, and incidental factors. It is now the practice of the Rand mining groups to take a conservative figure for the month's gold, which may be realized some weeks later, and to adjust the revenue up to the end of the previous quarter in the quarterly statements. But not until the yearly accounts are available, a few months hence, will it be possible to get anything more than an approximate estimate of the aggregate premium for last year. We can, however, frame two estimates of the magnitude of the premium. The Mines Department of the Union government adheres (with the wonted and rooted conservatism of the bureaucrat) to the fine gold standard. The Transvaal Chamber of Mines assesses the value on the estimated realization price. The Mines Department gives a figure monthly, showing what extra would be realized on the gold output applying the price assumed by the Chamber of Mines. The table herewith shows the increases in monthly value over that at the standard of £4.24773 per ounce, and the prices assumed for each month:

	Excess Over Standard	Estimated Realizable Value per Ounce
January	£759,650	£5.375
February	784,163	5.500
March	708,828	5.250
April	600,019	5.125
May	702,086	5.250
June	625,321	5.125
July	738,900	5.250
August	970,198	5.625
September	1,032,280	5.750
October	1,079,234	5.875
November	1,035,014	5.875
December	940,150	5.75
Total and average	£9,975,843	£5.475

The Chamber of Mines states the value of the gold production last year at £43,133,123, of course inclusive of gold premium; the Union Mines Department at £34,654,922, taking gold at the standard price, an indicated premium, by differences, of £8,478,201. Thus the premium on gold may be taken at eight and one-half or ten millions, the latter estimate containing the benefit of favorable exchange between London and Johannesburg, but when final accounts are available it may be found to be eleven millions or more.

PROFITS AND PREMIUM CONTRASTED

The vital importance of this premium is at once demonstrated by reference to the working profits of the companies. The total is £11,700,000, or not much more than the aggregate premium. But the government takes toll of the profits, and the actual sum distributed in dividends was £8,450,000. Thus, had there been no premium, there would have been no dividends, taking the average position; in point of fact many mines would have been closed down by economic elimination, and only the richer Far Eastern Rand group and possibly a mine or two mines near Johannesburg would have been able to survive and pay dividends.

It is not a question of deterioration in grade, but of an advance of 50 per cent in working costs since 1914 that has brought the Rand industry into such hectic dependence on the gold premium. In 1914 the average recovery for the Rand companies was 6¼ dwt.; last year it was 6.758 dwt. This rise is due to the growth of the Far Eastern Rand group of mines, to weighting the average, to the adoption of selective mining simultaneously with the advance in working costs, and to the closing of certain low-grade mines owing to the same circumstance, namely, that working costs have shot up from 17/7 to the alarming figure of 25/8 per ton, which corresponds with 6 dwt. at the standard price of gold.

What is "food" for the Rand is "poison" for the rest of the world. Great Britain wants the sovereign back to $4.85; the Rand (at any rate as far as gold is concerned, and apart from other countervailing considerations) would like it $3.65. The fluctuation in the price of gold is of enormous significance to the Rand. In

October and November the price was 117/6 per fine ounce. At first it was proposed to assess the January output at 107/6, but owing to the decline in the second part of the month the figure has been modified to 105/– With an output of 8,000,000 oz. a year, it is easy arithmetic to see that every half-a-crown drop involves a shrinkage of a million in currency value of output and a million a year in profit. In a month or in two months no less than £5,000,000 a year has been lopped off the Rand's profit. From a million and a quarter in November, the total will have dropped to something like £850,000 for January.

There has been a constant rise in operating charges since 1914; the full effect of the war on the cost of supplies was not felt for a year or two years, but in 1917 there was a rise of 1/– per ton, in 1918 of no less than 2/5, then of 1/4. The jump of 2/9 last year is the highest on record.

Labor's Remuneration Increased

Up to the end of 1919 the mining companies had met the extra cost of living with which employees were faced by a war bonus on the 30 per cent scale, so allocated that lower-paid employees received the full amount, and diminishing as the rate of pay advanced. Single men without dependents received no allowance. But in December of that year it was agreed to give all employees a flat £3 15s. 6d. per month, and an extra £1 3s. per month for each total dependent. For an average family, man, wife and three children, the allowance worked out at £8 7s. 6d. per month. The cost of these allowances was in the neighborhood of four and three-quarters millions (sterling) a year. But in February, 1920, the Chamber of Mines, on representations of the Federation of Trades and the unions, in view of the gold premium being obtained, agreed to consolidate wages and cost of living allowances on the basis of 40 per cent rise in cost of living. Eventually this was agreed upon at £10 8s. per month, being on the basis of twenty-six shifts at the pre-war standard of a sovereign a day. Mine officials earning up to £75 per month received 20 per cent. These allowances were made retroactive to November, causing the February expenditure to advance to £2,689,000, as against £2,505,000 in January. Though the average cost for the year was 25/8, the figure for December was 26/10, representing 6.3 dwt. at standard price. In this connection it should be noted that 40 per cent of the Rand's ore reserve averages less than 6½ dwt. Allowing for metallurgical losses, it is probable that 7 dwt. *in situ* is the minimum required to balance existing working costs. Increased assessments under the Miners' Phthisis Acts are also a material factor in enhanced costs, and the price of stores continues high. Natives received an increase in February.

The unions have lately asked for a further 6d. per hour. The Chamber of Mines has pointed out that, if this were granted, the native workers, of whom these are 160,000, compared with about 21,000 whites, would not be content with existing rates of pay. Last year each ounce of gold cost £3 17s. 6d. At nine low-grade mines it cost 100/–; at four high-grade mines less than 50/–. But if an increase of 20 per cent in white wages and 20 per cent in native wages were conceded, there would be a dozen mines (including the important Randfontein and the East Rand Propietary, each capable of crushing 150,000 tons a month) whose cost per ounce would exceed the current price of 105/–. These demands again are being insisted upon, despite a decrease in the cost of living index figure.

The tonnage milled was twenty-four and one-half million tons, practically the same as in 1919, though the expenditure was £3,300,000 additional. Only thirty-nine companies are now working. Five of these cannot pay with gold at 105/– per ounce, and at least another four would be left with the narrowest of margins even if the premium be maintained at 20/– per ounce. Five properties are approaching exhaustion.

Six companies dropped out last year, two in the low-grade Germiston district. The Jupiter and the Simmer Deep surrendered in the fight against ever-increasing working costs that were for a time combated by selective mining. Moreover, they were faced with the necessity of providing fresh capital for shaft sinking and development. A third, the Knights Deep, was closed down owing to its mill being destroyed by fire. This was financially better than running the mine and the shares appreciated from 4/6 to 10/6 (par value £1) chiefly in consequence of the funds to be provided on the insurance policies. Three historic mines, the New Heriot, the City & Suburban, and the Village Main Reef, some of the oldest Rand concerns, having been registered in 1887, were closed owing to ore exhaustion, accelerated in the case of the latter by a severe earth tremor causing the collapse of stopes. One new mine, the Modder East, began milling with a hired reduction plant. It has since acquired that of the Simmer Deep-Jupiter mines, just mentioned.

Dividends, Eight and One-Half Millions—One Mine Contributed One and One-Half Millions

As earlier noted, Transvaal gold mines earned profits of £11,700,000, as against £10,436,500 in the previous year, when, however, the gold premium applied to five months only. Dividends figured at £8,450,000. The outstanding performance was the distribution of £1,435,000 by the New Modderfontein, unparalleled in Rand annals; though, immediately after the amalgamation, Crown Mines declared over a million for four consecutive years. The advance by the New Modder for the year is no less than £455,000. Among other great mines, Van Ryn Deep paid £777,980, and Modder Deep £725,000. The Crown Mines, a Central Rand concern, revived by the gold premium, distributed £728,582, and Government Areas (in which the Union Government is today a senior partner, receiving by way of royalty two-thirds of the gold premium), £700,000. The mines of the Eastern Rand district were responsible for £5,185,350, representing about 62½ per cent of the whole.

A Policy for 1921

What does 1921 hold for us? The answer must be in the form of another question—What will the currency premium average? That is the economic girder from which the fortunes of the Rand depend. If the premium recedes, we may obtain certain advantages in the price of supplies. Already zinc is much cheaper, though cyanide is higher. But it is at least problematical whether labor, unless its temper changes materially, will surrender a large proportion of its higher wages unless compelled by the *force majeure* of shutting mines. The policy of the Chamber of Mines in agreeing to deduct union subscriptions from wage checks is insistently criticised as assisting the men in fighting the mines. What was justified in 1915 in the midst of war is mere foolishness today. Controlling houses

endeavor to reduce working costs, as far as may be, *pari passu* with a falling gold premium. A premium of a sovereign an ounce translates into 6/8 per ton, which means that we have to get back to the 1917 figure of 19/– per ton milled.

It is a hoary saying that in gold mining every sovereign produced has cost 25/–. The Rand cannot go on producing an ounce of gold at a cost of £3 17s. 7d. per ounce, and relying upon a fluctuating currency premium, which may be ephemeral, for its profit. Mining engineer friends in London, when I was over on vacation last year, told me that in reporting on mines they based calculations on standard value only, which is the only sound policy. I am doubtful whether costs can be reduced by 3/– a ton, unless conditions change materially.

A PERFECT CONE
The angle of rest of the granulated slag is thirty-one degrees.

The Disposal of the Granby Slag

For Ten Years This Waste Product Has Been Granulated and Stacked on the River Bank With Conveyor Belts

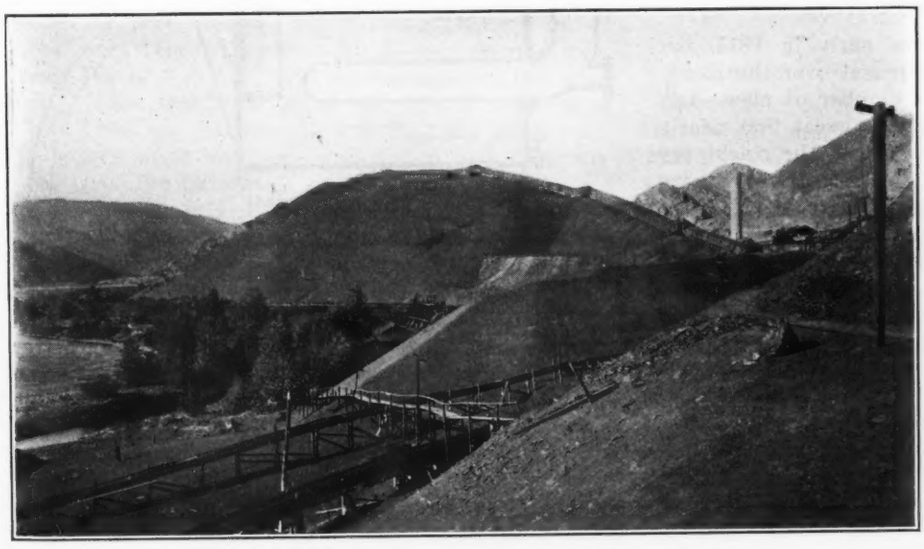
BY C. M. CAMPBELL
Written for *Engineering and Mining Journal*

THE GRANBY SMELTER at Grand Forks, B. C., now being dismantled, will leave, as a monument of twenty years' busy work, two enormous slag piles. From a distance they stand out on the landscape like the pyramids. In the early years the slag was granulated and flushed out over the area below. Later, when the available space filled up, the slag was poured molten, and in the course of a few years the area was again filled up with a mass of slag which extended along the river's edge in cliffs nearly 100 ft. high and a mile long. It then seemed to be necessary to transport the slag elsewhere, divert the course of the river to acquire more land, or take to the air like the birds. The last scheme was decided on, and since 1911 all the slag has been stacked.

At first, trestle work with a belt discharge 100 ft. above the old slag pile was built, and when this was filled in, further construction was made on the gradually rising slag pile. The granulated slag from the furnaces was carried along slag-lined launders to a dewatering bin, under which was a horizontal belt conveyor discharging to a north or south series of belts, as desired. In this way slag could be dumped at one place while extensions were being built at the other. The bin also had a capacity for several hours' run, so that the belts were not running continuously.

At the last, over a mile of 30-in. rubber belt was used, and the system was divided up into several units, each with an independent motor. Each end section was equipped with a telescopic belt, for discharging, which was moved ahead with a pair of jacks as required. The cost of handling under normal conditions was slightly under 4c. per ton.

The system was due to the initiative of F. M. Sylvester, general manager, and was carried out by W. A. Williams and W. B. Bishop, successive smelter superintendents. In general granulation is not a popular way to dispose of slag by American smeltermen, although costs at Grand Forks were satisfactory. Where sufficient space is available below the furnace level, the slag is ordinarily poured molten from mechanically tilted pots. With the closing down of the Grand Forks plant, the Washoe smelter at Anaconda is the only prominent American copper plant where slag granulation is practical. The illustrations presented on this page show the remarkable topographic changes such slag-disposal operations produce.



IN COMPETITION WITH THE SURROUNDING HILLS
The north slag pile, 300 ft. high and 3,000 ft. long, contains ten million tons.

Early Steam Pumping in Peru

Steam-Driven Pumps of Primitive Design Were First Used At the Cerro de Pasco Mines in 1816, and Were the Invention Of Richard Trevithick, a Cornishman Born 150 Years Ago

By W. B. Paley
Written for *Engineering and Mining Journal*

ONE DAY, in the year 1811, a Spanish merchant from Lima, Peru, wandered disconsolately about the streets of London, feeling that he had come half-way around the world to no purpose. Deputed by wealthy business men of the Peruvian capital to inquire about the possibility of unwatering the drowned-out mines of Cerro de Pasco by steam power, he had consulted Boulton & Watt, of Soho, Birmingham, with discouraging results. They considered it would be quite inapplicable under the peculiar circumstances to be met, the light atmosphere of a place nearly 14,000 ft. above sea level, and the difficulty of getting such bulky machinery over the mountains.

By good luck, however, the Spanish agent, Don Francisco Uville, chanced to see, in a London shop window, a neat, compact model of a high-pressure engine, guaranteed to work without condensing water, clumsy and heavy beam, or an enormous cylinder. Securing the prize at once, he brought it home by the first ship he could find, got it up to Cerro and raised steam. Rather to his surprise, it worked as well there as it did in London. The little engine bore the name of its maker, Richard Trevithick, of Camborne, in Cornwall. Uville and two others obtained a concession from the Viceroy of Peru to drain the mines, if they could, upon very liberal terms. Going back to England again in May, 1813, Uville met Trevithick and learned all he could about steam pumping machinery.

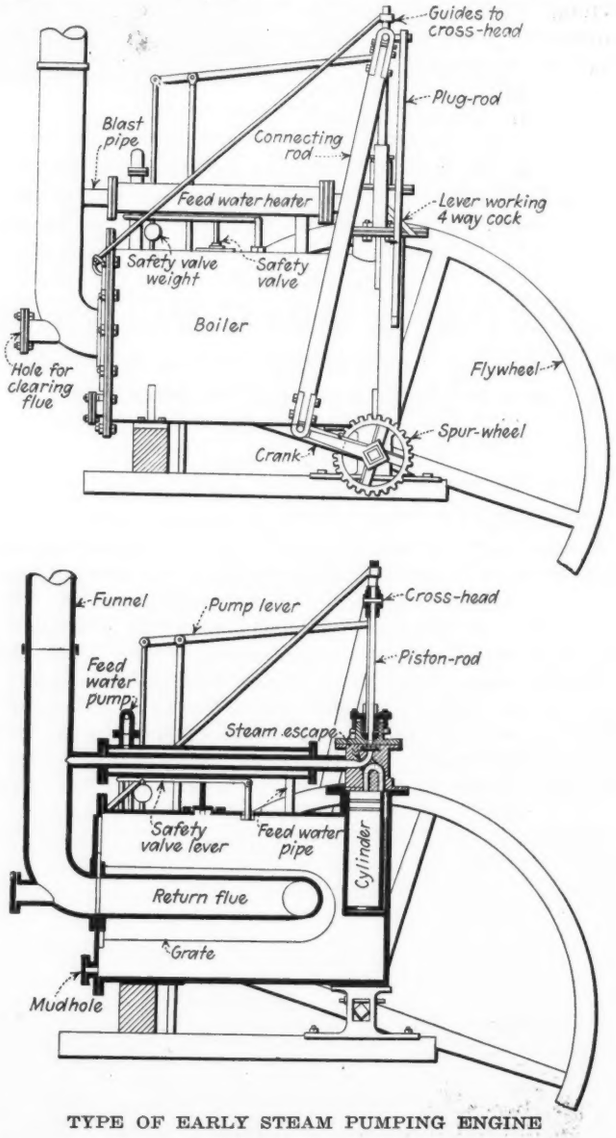
The visit resulted in an order for four pumping engines of 33 hp. each; four winding engines of 8 hp., and a portable engine, also of 8 hp., for general purposes. They cost £6,838, but a rolling mill, a mill for grinding ore, duplicate parts, miner's tools and ladders, with freight and insurance, brought the total cost to £16,152.

Results of Early Pumping

The consignment reached Lima early in 1815, but the difficulties of getting the shipment over the mountains, and having an inadequate number of men—only three—sent out to set it up, were so great that nearly a year and a half elapsed before any of the machinery was put to work at the mines of Cerro de Pasco. Every care was taken that the various parts of the engines should not be heavier than a mule could carry. To this end the boiler plates were taken up separately and riveted on the spot. However, eighteen months does not seem long for the job, all things considered, and the first engine was started at the Santa Rosa mine on July 23, 1816, and this seems to have answered the purpose extremely well.

The Governor of the Province of Tarma wrote to the Viceroy of Lima, describing the operations of the engine with great enthusiasm, although he had probably never seen any sort of steam engine at work before, and was therefore greatly impressed. The winding engine, erected at the same mine and driven by steam from the same boilers, also worked well. Similar results followed with another pair of engines put down at the Yanacancha mine in February, 1817. In fact, it is stated to have cleared the mine in nine minutes!

Both mines were speedily at work again, and everything seemed to promise well. It was soon found, however, that more competent knowledge and better directing power were necessary if the drainage scheme was to be carried out efficiently on a large scale. One of the three Cornishmen was dead; Don Francisco Uville was but an amateur mining engineer, and found the direction of the business somewhat beyond his powers. Trevithick, therefore, decided to go out himself, and landed at Lima in February, 1817, with eight more engines which embodied some improvements on the first ones. He found two pair of the latter not



TYPE OF EARLY STEAM PUMPING ENGINE

yet erected, and how much more machinery was ever got up to Pasco seems uncertain. Part of the plan was to sink a central shaft at each group of mines, into which those which required pumping could drain. The following letter from Cerro, under date of Sept. 20, 1816, gives a good idea of the scheme: "By dint of searching after a vein of coal, we have at last found one near at hand, of excellent quality and of great richness. The pit which we now work is at the distance of a quarter of a league from Rancas and at the same distance from Vista Alegre which the Cerro is from these works. We have likewise found a vein of plumbago, which was an object of search on the supposition that it was coal. This substance, of which much is consumed, mixed with grease to soften the friction of the piston, etc., we have now here, and thus the necessity of sending to Lima, or perhaps to Europe, for it, is obviated."

Characteristics of Early Pumping Engine

Each of the pumping engines was provided with an open-topped cylinder 24 in. x 72 in., with a crosshead working in guides, and side rods connecting to the pump rods. Two valves turned the steam on and off from under the piston, with the ordinary gear and handles. A balance beam regulated the movements, as there was no great main beam. The 8-hp. winding engine had an open-topped cylinder, 12 in. x 42 in., sunk for most of its length in the boiler, steam being admitted by a cock moved by an eccentric on the flywheel shaft. The gradual closing of the cock reduced the supply of steam at one-third stroke, and quite cut it off soon after, then exhausting through the blast-pipe into the funnel. The down stroke was made merely by the weight of the heavy and deep piston. Thirty strokes a minute, at 30 lb. boiler pressure, was the usual working rate. The boiler was of wrought iron, with an internal flue and grate, but could be worked with the grate just under the boiler if necessary, brick flues directing the heat along the bottom, out through the tube, and up a chimney. This alternative system was devised to meet conditions produced by the use of poor coal, or even wood, as fuel. The internal grate was large enough for good coal, but was not suitable for other forms of fuel.

Richard Trevithick was undoubtedly the pioneer in the use of high-pressure steam, but the term is, of course, only relative. About 40 lb. per square inch, against Watts' 3 or 4 lb., and condensing, was his usual mark. More than that made the rough boiler-work of this time leak badly. At first he used small cast-iron boilers made with one end dished and the other open. Over the latter was bolted a wrought-iron plate with a tapering return flue riveted into it. Cast iron being found unreliable, he used wrought iron, to the same design. Specimens of both kinds are at the South Kensington Museum, in London.

Use of Pumps Made Working of Mines Possible

No drawings are known to exist of the actual engines Trevithick sent to Peru, but their general arrangement can be inferred from what has been recorded of his practice. All the same, he was a highly versatile and ingenious mechanician, always making improvements. Except for the cast-iron boiler, it is believed that the diagrams here shown represent his small winding engines. The mines were of little depth, but had been pumped by manual labor under such difficult conditions that the native population was rapidly diminishing. As the mines slowly deepened, work in them became more and more intolerable, till at last the workers rebelled. In fact, as in Cornwall in Trevithick's youth, it had become impossible any longer to work the mines without something better than muscular power.

Trevithick superintended the Cerro de Pasco mines for two or three years. He was nobly supported by the Viceroy, but found his Spanish colleagues so jealous and impracticable that at last he left them. Soon after this, civil war broke out; the mines were seized by the government troops, and the machinery was dismantled to prevent the insurgents using it. Trevithick then went to Costa Rica, prospecting for minerals, but he met no success, and finally reached home, with empty pockets, in October, 1827. The work he did bore fruit, however, and in a few years steam power was again being used in Peruvian mines.

South America undoubtedly owes much to the genius of Richard Trevithick. He was born in Cornwall just 150 years ago, on April 13, 1771, and died, poor and alone and among strangers, on April 22, 1833.

Tasmania's Mineral Production

A table prepared by the Mines Department of Tasmania showing the quantity and value of mineral products for the State of Tasmania during the year ended Dec. 31, 1920, follows:

Mineral	Quantity	Value, Pounds
Gold, ounces	6,246.192	29,796
Silver, ounces	623,359	166,767
Lead, tons	3,855.639	142,268
Copper, tons	4,791.750	528,237
Tin, tons	1,310.411	3,693.362
Coal, tons	75,429	64,005
Wolfram, tons	70.89	13,626
Bismuth, tons	0.10	9
Shale, tons	140	172
Iron pyrites, tons	4,440	7,346
Scheelite, tons	105.09	179,905
Osmiridium, ounces	2,009.196	77,114
Asbestos, tons	.....	.....
Zinc, tons	9.30	334
Barytes, tons	1,048	4,163
Total	.....	£1,421,104

The Electrolytic Zinc Co. recovered 5,809 tons of zinc, valued at £251,130, and employed an average of 970 men.

Calcareous Marl Production Increased in 1920

Reports made to the U. S. Geological Survey show that 97,487 short tons of calcareous marl, valued at $322,329, was produced in the United States in 1920, an increase of 6,050 short tons over the quantity produced in 1919, but a decrease of $4,955 in the total value of the product. The average price per short ton was $3.31 in 1920 and $3.58 in 1919.

Most of the marl sold in 1920 was used in agriculture, in the same manner as pulverized limestone and agricultural lime, but some was used as a filler in patent fertilizer. In Arkansas, where the product included chalk, a small quantity was sold as whiting, which brought a much higher price than the agricultural material.

Nearly one-half of the total output—42,510 short tons—was produced in Virginia and was valued at $143,373. The other producing states were Arkansas, California, New York, North Carolina, Ohio, South Carolina, and West Virginia.

What Is the Ideal Drill Steel?

Conclusions and Results of Numerous Experiments and Tests Which Included All Types of Bits, Grades of Steel, and Various Grades of Rocks—Theoretical Ideal Drill Steel and Suggestions for Future Experimenting Are Offered

By Frank H. Kingdon*

THE SUBJECT of drill steel may be made a broad one. In writing on it one could include its history and development, its manufacture, its shapes and sizes with uses, its different types of bits and shanks and their advantages and disadvantages, its forging and hardening or heat treatment, and perhaps other relative matters with respect to drill steel. I have not taken any particular one of these, and so may touch slightly on each one.

In giving data and conclusions from experiments conducted by the Sullivan Machinery Co. it is necessary to mention statements which have heretofore been published indirectly through this company, so I claim nothing new or original in what follows, and offer the suggestions in the hope that they may prove of value in future experiments.

Necessary Considerations in Steel Preparation

The essential qualities of a drill steel are: First, it must be easily forged; second, the forged bit end must be such that it can be easily heat treated to obtain hardness to resist chipping; third, the bar or body must be stiff to resist bending or twisting and yet tough to resist shock and vibration, with resulting breakage, and fourth, the forged shank end must be such that it can be easily heat treated to obtain some hardness with great toughness.

Drill steel must be properly forged either by hand or machine, and this operation requires pyrometric control. I believe two causes of grief can be eliminated at this point, as there is no doubt that drill steels as a rule are forged at too high temperatures, and the forging operation is continued after the temperature has dropped below the critical. Furthermore, little if any annealing is done on drill steel after forging; hence the forging operation must be conducted with great care.

Assuming the forging temperature is correct, the other minor requirements are that the bit and the shank be in alignment with the body; that the shank shall be of the proper shape and length and the shank collar or lugs be of the proper diameter and length; that the hole, if any, be free from obstruction; that the striking end of the shank be flat and square; that the bit be of the proper shape, with the cutting and reaming edges formed full and to the required size; that the reaming edges are concentric with the axis of the steel, and that there are no sharp corners at the shoulder where the bit blends into the body.

Advantages of Machine Sharpening

It is obvious that the above requirements can best be obtained day in and day out by means of a drill steel sharpening machine. The efficiency of such a machine will accordingly depend, first, on the initial forging temperature required, for the lower the initial forging temperature the better the steel structure; second, on the accuracy of the forged bit and shank; third, on the speed of operation; fourth, on restriction of the hole in the shank and bit when using hollow drill steel; fifth, on the number of heats or times required to heat the steel before securing the finished bit or shank, and sixth, on the air consumption or power required. The means of heating for forging will be considered later.

The drill steel must have an ideal bit and shank. The essential qualities of such a bit, regardless of the conditions under which it is operated, are that its shape be such that maximum cutting speed can be maintained for as great a distance as possible before wear of the gage and cutting edge reduces the speed of penetration to a point where a change of steel is made necessary, and that the size or diameter of the drill hole corresponding to the gage of the bit can be maintained with the least possible reduction as the depth of the hole increases, and also that the shape of the bit is such that it can be correctly and readily formed and heat treated.

Difficulties in Standardization of Bits

It is doubtful whether a standard bit can or will be developed that will suit all conditions, such as the force and frequency of the blow transmitted to the bit, the speed and strength of the rotation imparted to the drill steel, the character of the rock as regards hardness, abrasion and other factors, and the method for ejection of sludge or rock cuttings. Accordingly, the following features of bit design require attention: Shape, total length, and angle of cutting edge; length and area of the reaming edges or surfaces; size and shape of clearance grooves for ejection of cuttings, and length and angle of the wings and the manner in which they are blended into the body of the steel.

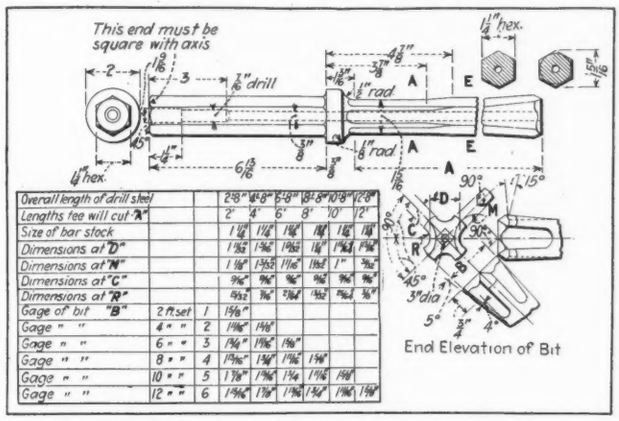
The combined length of the cutting edge and the manner in which it is applied is a big factor in the drilling operation regarding the speed and the life of the drill steel and the drill. The longer the cutting edge the greater the amount of rock cuttings per blow, assuming that the cutting edge is and remains sharp or sharp enough for the conditions. Furthermore, the drilled or blunt edge, besides decreasing the penetration per blow, lessens the cushioning effect, and this causes the drill steel to rebound from the rock, which may cause breakage of the drill steel or parts of the drill. In a radial cutting-edge bit the work done is greatest at the extreme cutting and reaming edges, which accounts for the unequal wear along the cutting edge. Therefore it is apparent that the only way to improve this condition is so to shape the cutting edge that the work is evenly distributed throughout its length, and so that the extremities of the cutting edge have suitable reaming surfaces properly tapered back to improve the wearing qualities of the gage.

A good deal has been written about the angle and shape of the cutting edge, and many kinds of bits have

*A paper presented at a session on "The Heat Treatment of Drill Steel," on Feb. 16, 1921, at the 123d meeting of the A. I. M. E.

been brought out, such as the bull bit, rose bit, double cross bit, chisel and double chisel bit, and other types; but so far as I know the only bit that approaches the ideal bit is the double-arc, double-taper bit. The accompanying illustration shows the characteristics of this bit and the features relative to this discussion, and needs no further explanation. As to the ideal shank, there is no doubt that the so-called shankless steel approaches the ideal, and it is regrettable that this type is not suitable for all conditions. Its advantages and disadvantages are evident.

The third and last requirement of the drill steel which has ideal qualities is that it must be properly heat treated. This without doubt is the most essential



Overall length of drill steel			2'-8"	4'-8"	6'-8"	8'-8"	10'-8"	12'-8"
Lengths tee will cut "A"			2'	4'	6'	8'	10'	12'
Size of bar stock			1 1/8"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
Dimensions at "D"			1 3/32"	1 5/32"	1 9/32"	1 1/4"	1 13/32"	1 13/32"
Dimensions at "N"			1 1/16"	1 3/32"	1 1/16"	1 1/32"	1"	31/32"
Dimensions at "C"			9/16"	9/16"	9/16"	9/16"	9/16"	9/16"
Dimensions at "R"			9/32"	7/16"	5/16"	11/32"	15/32"	15/32"
Gage of bit "B"	2 ft. set	1	1 5/16"					
Gage " "	4 " "	2	1 11/16"	1 1/16"				
Gage " "	6 " "	3	1 3/4"	1 11/16"	1 9/16"			
Gage " "	8 " "	4	1 15/16"	1 3/4"	1 11/16"	1 1/16"		
Gage " "	10 " "	5	1 7/8"	1 15/16"	1 1/4"	1 11/16"	1 1/16"	
Gage " "	12 " "	6	1 15/16"	1 7/8"	1 15/16"	1 3/4"	1 11/16"	1 1/16"

DOUBLE-ARC, DOUBLE-TAPER BIT

operation in securing best results, and yet it is safe to say it receives the least attention. The good results which are expected from all previous operations can be obtained only through proper heat treatment. Theoretically, this operation of heat treating should be simple; practically it is not, for all too much depends on the equipment.

I desire to call attention to a few essentials. First of all, the pyrometric equipment, which is in a way the most important piece of apparatus for obtaining best results. It should be sturdy and accurate, and the cold junction should be automatically taken care of or compensated for. This function I believe is best accomplished by using lead wire of the same composition as the thermo-couple, thus bringing the cold junction to the indicator or galvanometer, where it can be compensated for by means of a coil. Of the different systems of reading the temperature I believe the potentiometer system is the most reliable for the drill steel hardening shop.

Of equal importance is the furnace, which should be so constructed that it can be used in heating for forging and tempering, that it can be adapted to heat any size or shape of drill steel, that the burner be placed so the flame does not hit directly on to the metal, that for continuous work the heating chamber have its maximum heat zone at the end from which the drill steel is withdrawn, and that the pyrometer or thermo-couple be installed in this end.

Without giving further description of the equipment, I will assume it is such that the following treatments can be accurately controlled and performed. In forging do not heat higher than 1,700 deg. F. (with steels containing about 0.45 to 0.55 carbon, somewhat higher temperatures may be used), and use that lower initial temperature which will leave the temperature of the steel just above its critical as the forging operation is finished; anneal after forging to secure uniform results by heating just through the critical; heat from 50 deg. to 75 deg. F. above the critical, and quench for hardening (with high-carbon, hyper-eutectoid steels it may be advisable to use somewhat higher temperatures to get the excess cementite into solution); draw the temper when necessary, depending on rock conditions.

In heating maintain a neutral or reducing atmosphere to prevent scaling and decarbonizing. Do not heat too rapidly or too slowly, but evenly and uniformly, as too rapid heating may develop checks or cracks, and too slow heating may cause soaking, which tends to large grain growth. For hardening, heat just above the critical temperature, as a properly forged steel quenched from this heat has in combination qualities of some toughness, with maximum hardness and maximum density. The quenching bath should be kept at a uniform and approximately constant temperature. In drawing or tempering, longer time periods at lower temperatures are better than the shorter time periods at higher temperatures.

To improve further the ideal drill steel it seems necessary to consider the steel itself. Is everything being done by the steel manufacturer that possibly can be done? I think not. But it would be useless for the manufacturer to bring out better steel and alloy steels when mine conditions are such that the present steel is not heat treated properly to obtain its maximum efficiency.

It is interesting to note that answers to a recent questionnaire brought out the following facts and are representative of all fields and conditions of mining.

To the question, what type of bit was giving the best service, returns showed that the double-arc, double-taper bit and cross bit were far in the lead.

To the question as to what necessitates the resharpening of the drill steels most frequently, wear of gage was unanimously first choice; chipping of bit was unanimously, with one exception, second choice; breakage of shank was unanimously, with one exception, third choice; upsetting of bit, upsetting of shank and breakage of body were about on a par for fourth choice.

To the question as to what was the direct cause of the necessity of resharpening, poor heat treatment was unanimously first choice, and faulty steel and severe rock conditions were about on a par for second choice.

The information set forth brings out two distinct facts which can be considered with equal advantage by the steel manufacturer as well as by those interested in this subject. There is no doubt that "wear of gage" depends on heat treatment, but, assuming proper heat treatment, could not a steel be developed which would improve this fault? For instance, chromium imparts to steel a quality of tough hardness with great resistance to wear and abrasion. Would such a steel improve our ideal drill steel?

With this in mind future experiments can be conducted so as to bring out the difference between high- and low-carbon steels, straight-carbon and alloy steels, high- and low-forging temperatures, annealing and not annealing after forging, and, as regards the body of the drill steel, the difference between steel as rolled and steel heat treated to obtain a refined sorbitic structure. Particular attention should be given to the temperatures, for little if any data in this particular have been given on such experiments as have been conducted.

BY THE WAY

Agin the Safety Movement

At least one miner, or perhaps he is a prospector, that we know of is not in sympathy with the "Safety First" movement. To him the safety engineer is anathema. He writes, "As for safety to mining acidents, all I got to say acidents dont allways happen the same way and no set rule can be applied for avoidence. What mining needs is to kill off all the mining engineers as sure thing flunkeys so that them that are willing to venture are not hung up on tetchnickle mining lore out of a book as a safe guide to mining venture, and as mining allways was a gamble and allways will be no insurance can be had Last, if Congress has money to throw at the birds it might pension all prospectors and make it worth while to try and find mines and until same assistance is rendered to the prospector other then mining engineers' long winded reports, mining will stay Bumm."

External Combustion

"M'son," said Cap'n Dick, "This 'ere pro'ibition surely be a turrible thing, an' one o' the worst h'affects is tha recollections that a chap do 'ave that 'elps to make tha memory green, as thee might say. Not that I lays a 'eap o' stock 'longside o' this 'ere 'ome-brew, but I h'unnerstan' there's a parcel o' it bein' made an' many chaps 'ave been h'injured in tha process. Remin's me o' h'ol Jim Berryman, 'oo used to work to tha Ridge mine forty year h'ago. Strange thing to say baout a Cornish boy, but Jim wuz a teetotlar. Never touched a drop o' liquor in 'is life. One time h'ol Jim wuzn't feelin' very fitty, an' 'e gaws to see tha doctor. Doctor said 'e wuz a bit run daown an' tol' un to drink a little beer h'each day to brace un h'up. So Jim sent 'is boy to tha tavern at Maple Grove, baout 'alf mile away, to get some o' they stuff. 'Appened to be one o' they cold Lake Superior days, an' tha beer froze solid afor' tha boy got un 'ome. Jim put they bottles be'ind tha kitchen stove an' went h'up-steers. Coorse w'en tha beer started to thaw, tha bottles busted, an' with a noise like a bloody blas' tha beer blaws all h'over tha kitchen, h'even h'up to tha ceilin', m'son. Jim comes tearin' daown tha steers, an' seein' tha mess all h'over tha place, 'e sez, 'Dam-me, if 'e wuz goin' to blaw any'ow, its far better to 'ave un blaw there than h'in my h'insides.'"

The Althouse Creek Discovery

The story of the discovery of gold in the early 50's on Althouse Creek, in Josephine County, Ore., is interesting. John Althouse, the discoverer, was working on prospects in Canyon Creek in the same valley, and without much success had sought information from the Indians encamped at the foot of Eight Dollar Mountain as to other possible sources of gold in the district. These Indians were not friendly to the whites, who were then usurping their country, but had favored Althouse. At all events the Indians possessed many large nuggets of gold, but would not divulge their source. One stormy night the old Indian chief called on Althouse, at the miner's tent, and told him he would take him to the source of the big nuggets. The trail led over flats, creeks, and by a tortuous path, until, after ascending a creek leading into the heart of the Siskiyou Mountains, they stopped at an elk pit. This pit was a deep hole in the gravel bed of the stream now known as Althouse Creek. The pit was covered and camouflaged with brush, designed to entrap the elk as they crossed the creek bed. The interesting feature to John Althouse was not the pit, but the pile of gravel thrown to one side. The high waters and winter rains had washed this out in a natural hydraulic operation, leaving exposed the nuggets, one of which the Indian chief casually picked up and handed to the eager prospector. It resulted in the maelstrom of gold-frenzied miners shifting from the west bank of the Illinois River to the tributaries on the east side. The Althouse strike was made, and millions in gold was recovered from the stream and from Sucker Creek, an adjoining stream, in the course of the several years following.

The Voice of Nature

"To him who in the love of nature holds communion with her visible forms, she speaks a various language," wrote Bryant. Snatches of the conversation may be heard at times by the attentive listener. The following from the *M. C. M. Lode* proves it:

Here's one for Seaman! Ask him if he knows that minerals talk to each other and call to their mates exactly as moose and many other animals. For instance the call of a topaz to its mate is "O-PAL, O-PAL."

This may interest him. W. L. C.

As a reminiscence of the field trip in geology tell W. L. C. that I am quite familiar with the language of rocks and minerals. Only a few moments ago I was in the laboratory and overheard Mag. Netite call to Sid. Erite and ask if he was Cumming to nite. Sid. replied "O nyx! I have just received two Quartz and I am going to Tac a nite and Goethite." Her only answer was "O cher!" A. E. S.

Anent Timeliness

"Joseph A. Kelly, of Bernard, Iowa, has been a late visitor at Mayer, looking toward reopening of the local onyx beds," writes a correspondent. Some one should sic Punctual Pete after Kelly and stop this sort of thing.

The Scientific Spirit

(With Apologies to Nobody)

BY FREEMAN FOSTER BURR

You musn't rely on what Smith has said,
  Or what Jones or Brown may say:
If you listen to them you'll be misled,
  For it's just the other way.
But follow me, if you would be free
  To help the truth along;
For I am right, and I know I'm right,
  And the rest of the world is wrong.

Now, Smith is a fool and a dolt at best,
  And Jones is no better than he:
And Brown and Robinson and the rest
  Are stupid as they can be.
So follow me, if you would be free
  On the wagon of truth to ride;
For I am right, and I know I'm right,
  And the rest of the world may slide.

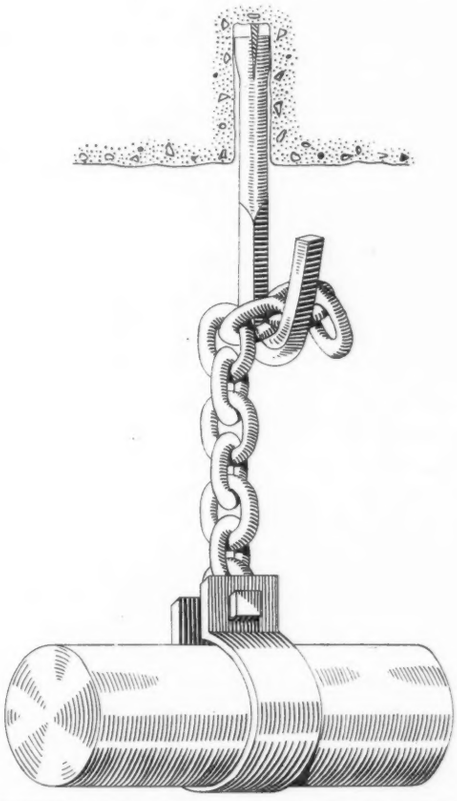
Oh! I am the only man who deals
  In facts and in facts alone;
And the only one who never steals
  The thunder that's not his own.
So follow me, if you would be free
  From the faults of the vulgar gang;
For I am right, and I know I'm right,
  And the rest of the world may hang.

HANDY KNOWLEDGE

Method of Pipe Suspension

BY R. P. IMMEL
Written for *Engineering and Mining Journal*

Following certain underground development, it was necessary to install two runs of 4-in. pipe in a drift 2,500 ft. long. Our practice in the past had been to hang these pipes from the roof to one side, and to make a neat job the pipes were suspended with turnbuckles so that they could be raised or lowered (owing to the irregularity of the roof) so as to keep them in alignment. This method occasioned many delays, because



PIPE MAY BE HUNG FROM A DRIFT ROOF IN MANNER SHOWN

the holes in the roof were either drilled too deep or not deep enough and because the irregularities of the roof were either greater or less than had been allowed for, with the result that the turnbuckle rods sometimes had to be taken back to the shop, either to be cut off or lengthened.

The accompanying sketch shows the method adopted to avoid this difficulty. It proved successful, and the lines were put in place with minimum delay. The hook bolt was split at the end and a wedge inserted, as is commonly practiced in fastening bolts or hooks in mining. The bottom of the hook was squared and then turned so as to make a regular chain hook that would hold the link of the chain when it was placed crosswise.

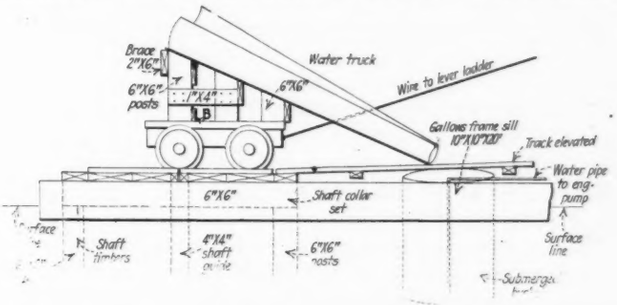
The chain was the regular standard log chain. The clamp was made from various short pieces found in the scrap pile and varied from ½ x 2 in. to ¾ x 4 in., and although it is shown in one piece in the sketch, it was in a few places changed to a two-piece pipe clamp.

On the actual work of installation, all holes in the roof were drilled first and the hook was driven in and fastened. Then several lengths of pipe were secured together and hung in place temporarily until a piece of chain could be cut off of such length that the pipe would hang level. A coil of chain was carried along with the job, and all that was necessary when the pipe was made up was to measure off a short piece, slip the bolt in the clamp through the link of the chain and hook the other end of the chain in the hook bolt.

Dumping Ore and Water

BY CHARLES E. DUTTON
Written for *Engineering and Mining Journal*

Certain methods or devices are described here which may possibly be found useful at shafts where ore and water are hoisted in buckets. At the shaft under consideration water was struck on the 300 level, draining

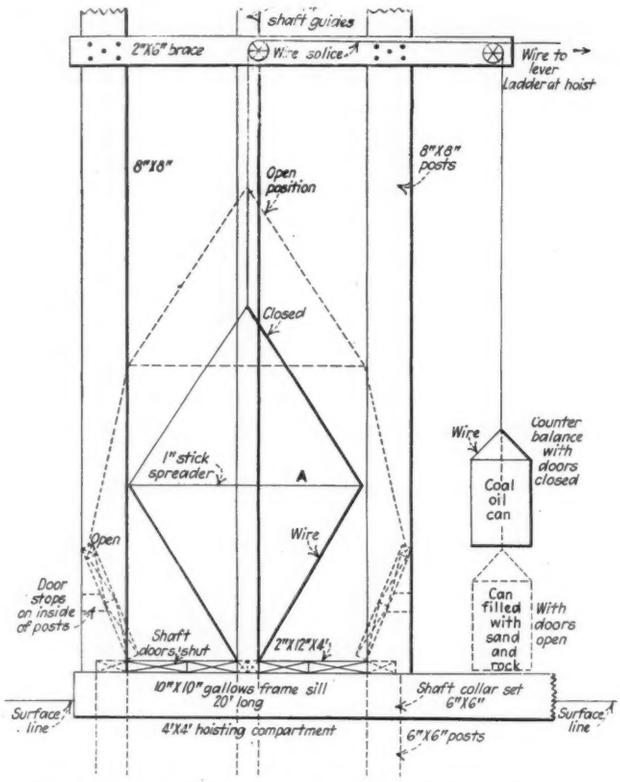


TRUCK USED FOR DUMPING WATER FROM SHAFT BUCKET

into the sump, whence it was disposed of as follows: First a hole was dug about 4 ft. from the collar toward the hoist, and an extra ore bucket placed in it, so that the top of the bucket was flush with the bottom of the track rails. The gas engine at this shaft included a small water pump for returning the circulating water to a tank overhead. The water line between this tank and engine was cut in on so that the pump would take water from the bucket between the rails or from the tank, as desired, by the turning of either of two valves within reach of the hoistman.

Then an extra truck was taken which had formerly been used in tramming buckets underground, and six 6 x 6-in. uprights were nailed on it. The front two were 6 in. high, those in the middle 12 in., and the two in the rear 18 in. Each set was braced crosswise with 2 x 6-in. planks. The middle and rear posts were also braced with strips on the sides. A quarter circle was then cut in the top edge of the uprights, as seen in the sketch, with the sloping center line as center.

In the sloping depression thus formed a funnel 3 ft. in diameter and 6 ft. long was fitted and nailed to the truck, so that the high back end was flush with the back of the rear posts and the lower front, or discharge, end was set so that it just cleared the crossties and the top of the bucket set in the ground between the rails,



METHOD OF OPENING SHAFT DOORS FROM HOIST

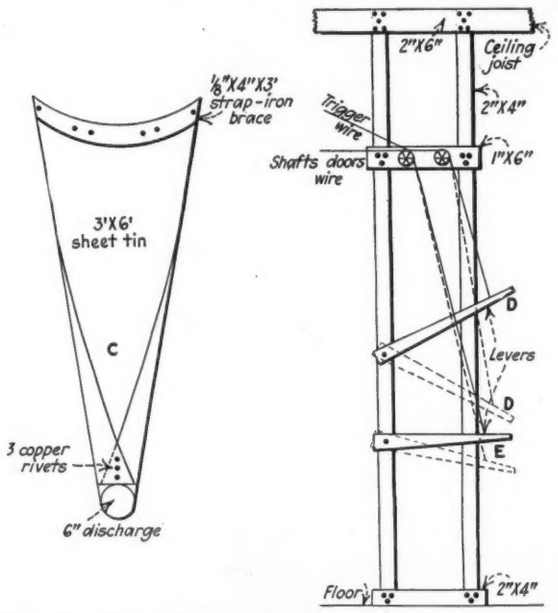
as the truck moved over the track. This funnel was made out of six Standard Oil cans, one can furnishing a 13 x 36-in. sheet.

The track was blocked up and graded so that the truck would run on to the shaft doors, when closed, under its own momentum, and stay there, further progress being prevented by a 2 x 4-in. timber 4 ft. long, which extended about 10 in. from the sides of the truck, and was nailed to the rear posts of the truck. These rested against the shaft guides and prevented the truck from moving at any time during the water-dumping operation. In this position the discharge end of the water truck funnel was directly over the rim of the bucket under the track. A wire was then attached to the truck and run to a lever on the "lever ladder" in the engine room, which on being thrown pulled the truck off the shaft doors some distance and locked it in place.

The "lever ladder" consisted of two 2 x 4-in. posts, conveniently situated near the hoistman while at his post, and braced at the base and nailed to the overhead joists. A 2 x 6-in. crosspiece to carry the pulleys was nailed or bolted to the posts at a height of 8 or 10 ft. The levers were made from 2 x 4-in. stuff, bolted at one end, with a hole for the wire near the handle end. Lever *D* opened the shaft doors with a 2½-ft. throw. Lever *E* released the trigger in the guide to hold up the crosshead, and had a 5-in. throw. The water truck lever, having a 4-ft. throw, and the ore chute door lever, having a 2-ft. throw, were both operated from the opposite side of the ladder, on the same principle, and are not shown in the sketch. The shaft doors and the ore chute door were counterbalanced with a weight to lessen the power required at the levers.

After a try-out it was decided that the crosshead must be hung up, so a trigger was rigged up to engage it when up near the sheave wheel. This trigger was operated by means of a wire connected to a lever in the engine room, and consisted of a long ⅝-in. bolt passing through a hole bored in the guide at the desired place. The bolt carried a spiral spring and washers, properly spaced with nuts, on the outside of the guide. The bolt was set so that the washers and spring held it in place, and was only pushed 3 in. through the guide when pressure was applied to the bolt head by a cam, controlled by the lever wire.

A device for opening and closing the shaft doors from the hoist is also shown in one of the illustrations. Baling wire or (mine) bell wire, two rope or wire pulleys, and a few bolts were used in making it. The stick *A* is simply a notched spreader wired in place. When



LEFT—FUNNEL USED FOR DUMPING WATER. RIGHT—"LEVER LADDER"

ore was hoisted it was dumped through a chute into a waiting car by the hoistman, the bucket being kept in the proper position by a chain and bar connected to a ring on its bottom, the bar engaging in a *V* notch in the chute during the operation. The chute had a swinging door 2 ft. long, which was moved in or out of position for dumping by a lever in the engine room.

The various devices worked satisfactorily. The procedure was as follows: When the signal to hoist was given, the bucket was raised. If containing muck it was stopped with the dangling bar ready to be engaged into the chute notch, while the chute and shaft doors were closed by levers. After being dumped, the doors were swung open and the bucket dropped to the station. While the bucket was being refilled the hoistman dumped the car and was ready for the next signal. If the bucket was signaled below the station, it was filled with water by submerging it in the sump. On coming up the crosshead was caught, the doors were closed, and the water truck was run on, all by throwing different levers. The bucket then descended and settled on the rear posts of the water truck, gradually tipping over and discharging the entire contents without spilling.

THE PETROLEUM INDUSTRY

Controlling a Gas Well at Alkali Butte, Wyo.*

BY F. B. TOUGH

An unusual job in controlling a gas well was executed on No. 1 well, Inland Oil & Refining Co., situated on the Alkali Butte structure, Fremont County, Wyo. The work was done by the company in co-operation with the U. S. Bureau of Mines, and resulted in a fuel saving of $6,000 in one season and of a repair job estimated at $15,000, or a total of $21,000.

The well had an open flow of 6,000,000 cu.ft. of gas per day, with a rock pressure of 560 lb. per square inch. A string of 6¼-in. casing with a toothed shoe was set on the cap rock above the gas sand at 2,481 ft. When the well was shut in, the gas worked out around both the 6¼-in. and 8¼-in. strings, breaking through the ground surface at several points under the derrick.

Casing troubles encountred while drilling made it unsafe to attempt moving the 6¼-in. string. Moreover, it was important from the standpoint of good management to make the gas from this well immediately available for fuel in other operations, and, in addition, to save the gas from wasting. An ordinary mudding and cementing job would have necessitated shutting down this well for probably two months out of a short operating season. For these reasons it was determined to mud the well, if possible, between the 6- and 8-in. strings by pumping mud fluid through the connection from the gas clamps. The gas clamps used were of ordinary construction with a side outlet, making them equivalent to a Braden head. When the mud fluid was pumped through the gas clamp into the space between the two strings, it began to appear inside the 6¼-in. string. It apparently entered the well either around the toothed shoe or through a "line sawed" leak in the string and was blown out of the well as fast as it was pumped in.

To stop the leaks, about half a gunny sack of finely chopped bull rope was fed with the mud between the casings as before. The hemp gathered around the valves of the mud pump to some extent, and it also stuck in the casinghead fittings a few times. An obstruction in the casinghead would be removed by permitting the well to "blow back" for a few seconds, and one in the pump valves, by removing the valves when necessary. In two days' time sufficient hemp and mud had been pumped into these strings to kill external and internal pressure. The well was shut in and allowed to stand over night. The next day, by opening and closing the master gate at intervals, and allowing the well to build up what pressure it would, it was found possible to blow the mud from the inside of the 6¼-in. casing.

The chopped rope had presumably gathered around the shoe and also filled any "line sawed" places in the 6¼-in. casing, and was holding place the mud fluid between the casings. The gas was thus made available for fuel, and the waste of gas by dissipation into the overlying formations and into the atmosphere was also prevented. It is interesting to note that after several weeks, during which period the mud had been afforded time to settle, a small amount of gas was observed leaking at the surface. About the same time it became possible to relieve the pressure by turning the well into the pipe line which had been laid to supply the camp and three drilling wells. A pop valve placed in this line was regulated by experiment to pop off at a pressure slightly less than that pressure at which gas would begin to leak at the surface around the well. Because of the demand for gas, the pop valve was seldom called upon to relieve the pressure. The wastage of gas became so small that, considering the need for fuel, it was deemed an act of true conservation to leave the well in that condition.

Although this method is not recommended for use in a proven field, it was satisfactory in the operation described, where the economic conditions seemed to justify its use.

*From U. S. Bureau of Mines, "Reports of Investigations," March, 1921.

Peru's Petroleum Law Protested

A new petroleum law was passed on March 3 by the Peruvian Senate. As Congress adjourned on that date, the bill did not have an opportunity of being presented to the Chamber of Deputies, but there is every possibility of the bill becoming a law when Congress next convenes, on July 28. Claiming that the "exploration and the search for petroleum should not be taxed, but be encouraged by every possible means, for once petroleum is actually discovered in commercial quantity the government may demand a fair participation in the industry," Victor H. Solaini protests the bill as follows:

"The law does not read like prohibition to the casual reader, but in effect it makes both the search for and the development of petroleum in the Peruvian orient an absolute impossibility so long as it remains in existence.

"Peruvian lawmakers do not seem to realize that the Peruvian orient, commonly called the 'Montaña,' is one of the most inaccessible, least-populated, least-known, and least-developed territories in the entire world. No account is taken of the fact that outside its main waterways the territory is absolutely unexplored, that it is still occupied by savage tribes and that not even the most primitive geological survey has been made.

"The law grants two classes of concessions; viz., concessions of exploration and concessions of exploitation.

"If petroluem is ever to be developed in the Peruvian orient it is absolutely necessary that besides granting these two classes of concessions under greatly modified terms, a third class of concession must be granted, which may be called a 'preliminary concession of exploration.' Both the 'preliminary' exploration concession and the exploration concession proper that would follow, should be granted to bona-fide applicants absolutely free of any taxation whatsoever.

"It must be remembered that nothing is known whatsoever of the geological formation of the Peruvian orient. On all general geological maps of the world the Peruvian orient is marked blank and 'not known.' It is therefore absolutely necessary, before any capital can be invested, to send in a well-equipped and expensive expedition merely in order to ascertain if rocks can be located that belong to a geological period in which petroliferous possibilities exist.

"Anyone desiring to search for a geological formation that might indicate petroliferous possibilities in the Peruvian orient would have to apply for a concession of exploration before sending any expedition into the territory, for naturally no one would go to the great cost of even preliminary exploration without first being sure of possessing rights over the territory explored.

"This concession, therefore, would necessarily have to comprise an area sufficiently large to warrant the great cost of equipping, dispatching, and maintaining the expedition for a period of months or years. A reasonable size for this 'preliminary concession of exploration' would be an area of about 150 kilometers square.

"According to the law passed by the Senate, any enterprising gentleman desiring merely to search for petroliferous rocks under these conditions would first of all have to pay the Peruvian government a sum considerably in excess of 3,000,000 soles; and this is not all, for if he desired an extension of the privilege to remain in the area for any length of time, he would have to pay an additional sum of over one half million soles per annum."

The Holbrook Oil Field in Arizona

SPECIAL CORRESPONDENCE

Seven corporations are reported active within the Holbrook oil field, in Arizona, including the Adamana, Apache, Black Canyon, Holbrook, Hopi, Zuni, and Bankers. The field itself is of vast extent, covering the famous Painted Desert to the north of the Santa Fe main railroad line and extending down to Springerville, ninety miles southeast of Holbrook. At this latter point the Bankers' company, a close corporation, has started drilling. The entire field lies within two carboniferous districts—the Durango coal field to the northeast, with coal measures on the Navajo reservation, near Moen Copie, to the northwest, and to the southward, west of Fort Apache, still more coal, and on the east the Gallup coal fields.

Drilling by the Holbrook company is on a sandstone plain, where the logs for several thousand feet of depth show, in alternation, various forms of sandstone, limestone, soapstone, shale, and sand. In the Zuni well, twenty-two miles northeast of Holbrook, salt water was struck between 932 ft. and 945 ft. In the Adamana well, twenty-five miles south of Holbrook, salt water was encountered at 2,060 ft., together with a strong flow of gas. The Hopi, twelve miles southwest of Holbrook, is 2,400 ft. deep and is believed to be in practically the same bottom formation as the Zuni, though the latter is only down 1,000 ft. and there is belief that both are not far from what in the San Juan field, to the northeast, is called the "baby" sand.

Within the Holbrook townsite oil indications have been found in a shallow well driven by Harry Scorse. The field is considered a deep one, and the work has been retarded by extreme hardness of rock and by generally insufficient funds.

At Yuma a well has been started near the city, with a public demonstration in which hundreds of citizens joined. At Prescott and Jerome there has been revival of interest in the abandoned Chino Valley field.

William S. Hart, movie star, and Ralph Ince, film producer, have leased 5,760 acres in the Holbrook field from the Aztec Land & Cattle Co., with a guarantee of $5,000 for the starting of a standard drilling rig within ninety days. The tract is in the same district as the Hopi well. Ince and Hart have been associated in California oil exploration work. Other leases in the Hopi region are said to have been taken by Los Angeles interests.

Report on Peace River Block Favorable

SPECIAL CORRESPONDENCE

The Hon. Mr. Pattullo, Minister of Lands, recently submitted to the provincial Legislature the geological survey report of John A. Dresser, consulting engineer, and Prof. Edmund M. Spieker, of the Johns Hopkins University, on the Peace River Block, in British Columbia, which work was done during the summer of 1920.

Closer investigation was made of the areas described by the late Prof. Gwillim as being structurally favorable, owing to the rolls and folds of bullhead sandstone, the geological equivalent of the oil- or tar-bearing strata of the Lower Peace River, Athabasca River, and of the Black Diamond area in southern Alberta.

The report confirms that of the previous year as to the oil-bearing character of the St. John shales and the possibility of oil accumulations of commercial value in the porous sandstone beds or in the upper parts of the bullhead sandstones immediately beneath them, and suggests the most suitable points at which drilling may be started.

Promising locations were determined near the Gates of the Peace, on the Red River, on Lynx Creek, near the Southwest Halfway Creek, near the trail to Hudson Hope, and the anticlines of Miller Creek, Pine River, Table Mountain, Rocky Mountain Lake, Moose Lake, Flat Creek, Canyon and Bullmoose creeks and the Boulder Creek dome show possibilities.

The Boulder Creek formation is most promising, its dome-like shape making it almost perfect as a reservoir structure, and it is also underlain within 1,300 ft. of the surface by the lower sandstones of the Bullhead Mountain formation and the upper shales and limestones of the Pine River formation, a series at least 300 ft. in thickness, and probably more, which may contain petroleum; the extremely hard Boulder Creek member of the Bullhead Mountain formation has been cut away by erosion at the apex of the dome, and the amount of hard rock to be penetrated in order to reach the lower section is less than it would be elsewhere.

Though no unquestionable seepages of petroleum were observed, a seepage of gas was found on the west flank of the Boulder Creek dome, northwest of the drilling location selected. The gas bubbles up intermittently through water in a hole at the base of a tree, the roots of the tree undoubtedly affording a channel through which the gas escapes from the underlying sandstone to the surface. The gas is highly inflammable and contains a considerable percentage of hydrogen sulphide and it gives forth a strong odor of sulphur dioxide when burned.

Referring to the absence of oil seepages, the report states that vast oil fields, today yielding millions, exist without a single surface indication, so that their absence may not be taken as an unfavorable factor, provided the other features are favorable.

Summarized, the favorable factors are as follows: The presence of a number of formations in which oil could occur; the presence of anticlines which dispose the possibly oil-bearing strata favorably to the retention of petroleum, and the comparatively reasonable depth within which the beds to be tested may be reached.

The Minister of Lands considers the report an invaluable guide to exploratory drilling operations, and it also furnishes a large amount of detailed geological information which should prove of great scientific and practical service.

COURT DECISIONS IN MINING CASES

By Wellington Gustin

N. Y. Court of Appeals Sustains David Fox

Reverses Judgment in His Action Against the Arctic Placer Mining & Milling Co.

A decision favorable to David Fox in his action against the Arctic Placer Mining & Milling Co. is reported by the New York Court of Appeals. Fox had appealed from a judgment dismissing his complaint, and now obtains reversal of that judgment with a new trial granted. In his action Fox seeks to recover the reasonable value of his services rendered the mining company between November, 1913, and April, 1915. During this time he was a director and vice-president of the company, and owned 1,000 shares of its capital stock, of the par value of $5,000, for which he paid $50.

The company appears to have been organized in 1907 after a consultation between a Mr. Cutler, a Mr. Fallows, and Fox, a mining engineer with considerable experience in Alaska. These were the active directors, and they located gold mines in Alaska. In 1908 Fox went to Alaska and took charge of the company's work there, being paid $500 a month and expenses. Each summer until 1912 he went to Alaska to supervise the operations of the company. For some of these trips he was expressly employed and his compensation fixed; for others there appears no express contract, but he was paid for his services. In 1912 he remained in New York, where he did some consultant work for the company, without express contract, but received pay. In 1913 he was again sent to Alaska relative to negotiating an option for drilling and dredging lease of the company's property.

Thereafter in 1913 and 1914 Fox advised and consulted with various officers of the company, rendering some service of a technical engineering nature with reference to the lease proposition, the preparation of maps and plans, for the purpose of effecting a sale of the property to another mining corporation. The majority opinion says these services were different and other than those usually performed by an official of a corporation. They form the basis of this suit.

Officers and directors serve without compensation for performing usual duties, unless express provision is made therefor, either by statute, charter, or agreement, said the court. And if there is no contract for personal services expressed, it may be implied from the mere rendition and acceptance of the service, upon which the presumption is created that such services were to be paid for because no one is expected to labor without hire.

An agreement to pay may be inferred from a course of practice, or where the services are outside the usual duties of an officer of the corporation. Fox alleged special services were rendered as consulting engineer. Such agreement may be evidenced by proof or circumstances which tend to show that the services were rendered with the expectation on both sides that they would be compensated for.

The services performed included the drawing of maps, plans, making photographs of the ditch system of the Alaska property, the preparation of a long and technical letter, describing the nature of the company's property and the manner in which it could be worked to best advantage, and other professional or technical work. Such engineering and technical services are not usually performed by a director as such, said the court.

The trial court and the Appellate Division had held that the services rendered were within the line of Fox's duties as vice-president and director, and, there being no prior express contract therefor, dismissed his suit.

Creditor May Not Complain of Agreement Assented To

The Supreme Court of Arizona has dismissed the action brought by Thomas Allaire against the Laurel Canyon Mining Co., with the First National Bank of Globe, Ariz., as garnishee.

It appears that the Laurel Canyon Mining Co. was a judgment debtor of Allaire and it had empowered the bank in writing to receive from Ruff and Carlson, lessees of its mines, all payment of rent accruing on said mines to the amount of $25,000, and distribute such money pro rata to all the creditors of the mining company.

The creditor alleged that this agreement was in violation of law and void, for the reason it was made to hinder, delay, and defraud the creditors of the mining company. But it was shown that the complaining creditor was notified of the mining company's agreement with the bank and acquiesced therein to the extent of receiving a portion of the payments before beginning this suit.

Hence the court said that neither the plaintiff nor other creditor who accepted a dividend, or other benefits, knowing the same was offered and paid pursuant to the agreement, can be heard to complain that he has been hindered, delayed, or defrauded by that particular agreement, for the reason that such creditor has impliedly become a party to and is benefited by it.

Corporation Books Must Show Ownership of Stock

California Supreme Court Reverses Judgments in New Pedrara Onyx Co. Controversy

The Supreme Court of California has denied a rehearing in the controversy of J. A. Young and others against the New Pedrara Onyx Co. and others as appealed from the District Court of Appeal. The complaining parties were stockholders of the New Pedrara Mexican Onyx Co., a California corporation, suing on behalf of that corporation to set aside a resolution adopted by the company's board of directors, whereby, so it is claimed, the board rescinded a transfer to the company of certain shares of the stock of the New Pedrara Onyx Co., called the Mexican company.

Two actions were brought, and in both the trial court decided favorably to the defendants. Appeals were had in both cases to the Court of Appeal, and, after decision, rehearing was granted. The present decision is final on the points involved, and the lower judgments have been reversed.

The property involved consisted almost entirely of certain onyx quarries in Mexico. The court has said that from the date of the exchange of the California company's shares for those of the Mexican company, the directors and stockholders of the former seem to have treated that company as the owner of the quarries and of all onyx quarried therefrom. But the court thought from the facts presented that the Mexican company was and is the "owner of 5,000 acres of land in Lower California in which are situated the quarries of onyx known as the Pedrara Onyx Quarries"

The case was reversed and remanded for a retrial upon the single issue of title to the 100 shares of the capital stock of the Mexican company, and the latter company directed to register the shares so that its books will correctly show the ownership as well as the several interests of all rival claimants. be paid a fee of $5, which fee shall be considered as earned only if the entry shall be allowed. For filing and noting each yearly proof of labor or assessment work, a fee of $1. If final proof is made before the register and receiver, a fee $5 for each claim upon which proof is offered and 22½ cents per hundred words for transcribing the testimony offered shall be paid. If proof is made before any other officer a fee of $5 for each claim shall be paid the register and receiver, but no charge for examining the testimony shall be made, and no other purchase money, fees, or commissions shall be required to be paid by the mineral entryman.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Van. H. Manning Addresses Local Section of A. I. M. E.

Need of Definite National Petroleum Policy Emphasized—Committee Will Formulate One

The international aspect of the petroleum situation was discussed at the regular monthly meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers held on April 6. With an English engineer among the advertised speakers and others with British leanings expected to be present, some rather sharp discussion as to international rights in foreign oil fields was expected. In this, however, the audience was disappointed, for every one of the speakers seemed to agree with the others that the chief requirement for settling any existing disputes was co-operation and a willingness to understand the other fellow's point of view; that both the British and the American attitudes had a certain amount of justification, and that, after all, the question was more or less of a bogey which was causing more talk than the facts in the case would support.

Van. H. Manning, director of research for the American Petroleum Institute, was the principal speaker. He outlined the petroleum discussion between the United States and Great Britain, and made suggestions as to what should be done. Many British engineers were said to be unfavorable to the British attitude, and he thought there would be no trouble in coming to an understanding, provided the interested parties would get together and talk things over. Dr. Manning particularly emphasized the need of a definite petroleum policy on the part of this country, and stated that this was a matter which demanded immediate attention.

Lester H. Woolsey, who has been closely associated with former Secretary Lansing for some time, was scheduled for an address, but was unable to be present, and forwarded a paper to be read. His contribution enlarged further on certain of the points at issue.

J. A. L. Henderson, a mining engineer of London, was also unable to be present and assist in presenting the British point of view. However, several others conversant with British feeling in the matter spoke extemporaneously, and gave the impression that any fancied wrongs could be righted without hard feeling and that no encroachment upon national interests would result. One speaker pointed out that the oil supplies of the United States were in no immediate danger of exhaustion, because of the immense deposits of oil shale available.

Ralph Arnold and Leonard Waldo concurred with Dr. Manning in the necessity for an immediate decision as to an American petroleum policy, and resolutions were formulated for a committee made up of members of the American Petroleum Institute and the A. I. M. E. to study the matter and advise with the proper officials at Washington.

Cordilleran Section of G. S. A. Meets at Berkeley, Cal.

The annual meeting of the Cordilleran Section of the Geological Society of America was held at Berkeley, Cal., on March 26, in joint session with the Pacific Coast branch of the Paleontological Society, the Seismological Society of America, and the Le Conte Club. Among the numerous technical papers presented mining men might be interested in "The Probable Occurrence of Massive Triolite in Serpentine," "Jurupaite, a New Mineral From Crestmore," both by A. S. Eakle; "Collophane, a Much-Neglected Mineral," by A. F. Rogers; "The Temperature Range of Metalliferous Deposits Formed Near the Surface," by C. F. Tolman Jr.; "Some New Aspects of the Geology at Cobalt," by A. R. Whitman; "The Mechanics of the San Andreas Fault," by Prof. Bailey Willis; "The Jasperoid of the Joplin District, Missouri-Kansas-Oklahoma" by W. S. Tangier Smith; and "Certain Marked Differential Movements in the San Francisco Bay Region," by G. D. Louderback. Paleontologic papers were presented by B. L. Clark, Leonard Henry, Chester Stock, G. A. Wilcos, and others.

Colorado Alumni in New York Discuss Status of School

The Colorado School of Mines Alumni Association recently organized a New York Section, which is holding monthly meetings. The last one was on April 13, when the members met to discuss the administrative conditions obtaining at the old school and to hear the latest news concerning the activities of the state legislative committee appointed to investigate them. Various speakers presented almost as many different points of view, but all agreed on the fundamental need for a board of regents selected and appointed on the basis of their general abilities and qualifications fitting them to appreciate the intellectual and material needs of an institution devoted to technical and scientific instruction, and competent to defend its ethical and scholastic ideals. W. S. Medell, chairman of the section, and Harry J. Wolf, secretary-treasurer, were among the speakers.

F. A. E. S. Opens Permanent Washington Headquarters

All Committees Report Progress—Report on Waste in Industry To Appear in June—New Charter Members Coming In Steadily

Permanent headquarters of the Federated American Engineering Societies have been established in Washington. A desirable location has been secured on the third floor of the National Savings & Trust Building, at 719 Fifteenth St., N. W. Sufficient space has been obtained to accommodate the staff of the F. A. E. S. and at the same time provide a large lounging room or conference room for those who may desire to use the headquarters as a meeting place. Headquarters at all times plans to render as much personal service as possible to engineers visiting Washington, and special arrangements will be developed enabling them to transact business with the minimum amount of effort. Engineers, therefore, are asked to notify headquarters of an intended visit to Washington, so that arrangements may be made to care for them. Executive Secretary L. W. Wallace will be permanently in Washington in the near future.

There is great activity in a number of states regarding the licensing of engineers. It is not the desire of the F. A. E. S. to initiate such legislation nor to urge its passage, but it wishes to be instrumental, so far as possible, toward securing the passage of bills that will not be detrimental to public interests and to the engineering profession.

The Patents Committee has been carefully going over the matter of having a bill passed by Congress that will provide more adequately for the U. S. Patent Office, and has requested all member societies to urge upon Congress better support for that bureau.

The work of the Committee on Elimination of Waste in Industry is progressing according to schedule. The publication of the final report of the committee will be undertaken immediately upon the completion of the field work, on April 15. The report will be published some time in June. The findings of the committee thus far are significant, and it has every reason to believe that this report will create much interest.

Engineering societies that have not yet become affiliated with the F. A. E. S. continue to show interest in the Federation. In recent weeks two more have joined, namely, the Boston Society of Civil Engineers and the Engineering Society of Milwaukee, Wis. A number of other societies are either voting at the present time or have under con-

sideration by the executive board the question of joining the federation. It is reasonably sure that a number of other societies will become affiliated with the A. F. E. S. before July 1, the limiting date for coming in as a charter member.

Chilean Nitrate Fields Need Simple Strong Machinery

Labor Conditions and Mechanical Aids Described—Opportunities for American Makers Pointed Out.

Labor shortage prevailed last year in the nitrate fields of Chile, and there is little promise of improvement this year. This condition is paving the way for the eventually extensive introduction of American excavating and mining machinery. This will be accomplished, however, only by an aggressive campaign of education. Present-day Chilean mining methods are the same that have obtained for half a century. Hand labor prevails throughout.

In recent years the control of this territory has passed either into British or Anglo-Chilean hands, and though new capital and new energy have been introduced there has been no corresponding increase in efficiency of mining methods. Today the problem is to work over for the second or third time what was once considered waste material.

There is scarcely half enough labor to meet the demand. The labor problem was never so acute, nor with less prospect of relief. Moreover, the class of laborer that has appeared is about 25 per cent less efficient than the trained forces that deserted within the last two years.

All excavation work is done by hand with ordinary shovels. The rock mining is done by hand drilling and blasting. Separation of nitrate-bearing rock from the waste material is by hand. Loading is by hand. The blasted rock is broken into man loads by additional blasting and sledge work.

For years it was impossible to get a mechanical drill that would operate satisfactorily, because of the varying hard and soft strata and the interspersing loose pockets of sand. Recently, however, this difficulty seems to have been overcome by at least one American drill-manufacturing concern, which has been enjoying a monopoly of what little business it has been able to develop. But the field managers are mostly Englishmen, with an inborn British prejudice against anything American. This prejudice can be overcome, however, where it can be shown that dollars can be saved.

Half a dozen steam-shovel companies have been prospecting the fields for the last two years in an effort to introduce their machines for excavating and loading purposes. Their slow headway is due largely to the fact that deliveries in most cases require from four to eight months.

In clearing away the rock debris from blasting operations steam shovels that are equipped with continuous-tread trucks and can move about without the necessity of a wooden planking foundation will win quickest favor and prove of far the greater efficiency. The nitrate-bearing strata vary in thickness and occasionally pinch out without notice, always leaving an uneven pathway that tremendously handicaps the shovel not so equipped.

So far no steam-shovel manufacturing company has attempted to maintain a stock of shovels or parts at Iquique, the port of entry. Eventually this will have to be done if the steam shovel is generally adopted, as seems probable. Moreover, some service arrangement must be perfected to care for the machines in the fields.

There is, likewise, a continual demand for industrial railway cars. The northern Chilean districts alone require from two to five thousand annually. The general favorite is a two-way V-dump car. All are of 30-in. gage, and rails used for the tracks are mostly 25 lb. Wooden ties are used. Steam locomotives are used in hauling.

For handling the finished product, after the boiling and settling process has separated the nitrate from the raw material, a two-way dump gable-bottom car is used. These cars are not in so great demand, as their handling is less severe. Frames of this type are good for two years, but a body will last not more than half so long. Electric hoists are used in handling these cars, but are replaced only when they are worn out.

American ingenuity that will provide a mechanical sacking and loading equipment for use in these storage grounds may speedily enjoy a monopoly in this particular field. Sacks of nitrate are filled to carry 220 lb., and the sacking charge is approximately 1c. a sack. The unreliability of the class of labor that does the sacking provides a constantly irritating problem.

Nitrate is but one phase of South American mining that offers a potential market to American machinery manufacturers; and South American possibilities in all their varied lines will be discussed at length in the various group meetings of the eighth annual convention of the National Foreign Trade Council, to be held at Cleveland May 4 to 7. The convention will consider plans, possibilities, and ways and means of extending our foreign trade throughout the world.

European Child Relief Fund Receives Large Contribution From Mesabi Range

A total of $28,667.62, turned in or pledged, is the generous sum of money raised by the residents of the Mesabi Range of Minnesota for the benefit of the European Child Relief Fund, in response to a personal appeal made by Herbert Hoover at one of his talks in Duluth, Minn. This result has just been announced by Anton Tancig, the general chairman in his final report of the campaign committee appointed by the Engineers' Club of Northern Minnesota to carry on the campaign. Of this total $26,684.87 has actually been turned over to the European Relief Council by the treasurer, Ray Moore, of Hibbing; only $1,982.75 remains as pledges. Secretary Carl Calvin, of Hibbing, was also the publicity manager for the drive, and to his energetic efforts it owed much of its timely effectiveness. All three of the general officers were ably seconded by the eleven chairmen of the local drives.

The larger among the seventeen towns on the range readily raised the larger individual contributions, but each section gave so generously that only the full list would do full justice to all. It appears that the towns of the east end of the range collected $13,355.23, which was matched with $15,312.39 from the towns of the west end. Hibbing, Virginia, and Chisholm head the list with amounts in excess of $3,400 each, but Hibbing alone raised $7,501. There were seven localities whose contributions exceeded $1,200 each, and twelve towns raised more than $500. The systematic work of the Engineers' Club of Northern Minnesota thus brought in for this good work a sum much in excess of the quota for the range.

State Batteries and Cyanide Works Help Small Mines in South Australia

In South Australia the development of small mines and prospects is encouraged by the provision of government mills and amalgamation and cyanide plants. The report for the year 1919 has just been released. Work proceeded as usual at the Mount Torrens, Peterborough, Glenloth, and Tarcoola batteries and cyanide works. Eighteen parcels of ore were treated, weighing 224 long tons and returning about 245 oz. of gold bullion, valued at £846. In the course of the year 310 assays and pan tests of small parcels of ore of a few pounds' weight and ore under treatment were made. The total weight of tailings treated by the cyanide process amounted to 770 tons.

Of the total gold recovered, 199 oz. was recovered by amalgamation, and 45 oz. was recovered by the cyanide process. The average value of the ore treated for the twelve months was £3 15s. 7d. per ton.

The work carried out by the state batteries and cyanide works during the year has, in addition to the testing of small samples for the miners, made possible a return to the prospector of £720 5s. 11d. as proceeds on the treatment of the various parcels of ore; also, through the department being a member of the Gold Producers' Association, and as a result of the profits obtained through that association on the sale of gold to foreign countries, the government has been enabled to pay to the prospector a premium of 13s. per oz. on standard gold.

The total value of gold bullion recovered to date at the state batteries and cyanide works is £92,439 6s. 11d.

MEN YOU SHOULD KNOW ABOUT

Etienne A. Ritter, mining engineer of San Francisco, Cal., has been inspecting properties at Oatman, Ariz.

A. A. Leech, geologist for the Phelps Dodge Corporation, Tyrone, N. M., has resigned and will go to Mexico.

William T. MacDonald is now mill superintendent for the Moctezuma Copper Co., Nacozari, Sonora, Mexico.

James P. Porteus, mining engineer, of Lordsburg, N. M., is in New York City on professional business.

G. M. Colvocoresses, general manager of the Consolidated Arizona Smelting Co., Humboldt, Ariz., is in the East on professional business.

M. Gaviard, mining engineer and member of the class of 1904 of Saint-Etienne, has been appointed chief engineer of the Sarre mines.

W. P. Chinn, assistant general manager of mines for Pickands, Mather & Co., has returned to Duluth, Minn., from his extended southern trip.

Max H. Barber, general superintendent for the Cleveland-Cliffs Iron Co., on the Mesabi Range, has returned from an extended trip through the South.

H. W. Hardinge, mining engineer, of the Hardinge Co., New York City, sailed by the "Aquitania" on April 12, for London. He expects to be away about a month.

H. W. Davis, of the U. S. Geological Survey, has completed an extended trip for the purpose of gathering statistics on fluorspar, barytes, lead and zinc, and limestone.

J. Ross Corbin, consulting mining engineer, of Philadelphia, Pa., has been commissioned by State Geologist George H. Ashley, to study the iron-ore resources of Pennsylvania.

C. H. McCarthy, president of the Alcan Oil Co., New York, has returned from an inspection of the Fort McMurray oil field, where his company has made extensive investments.

R. J. Frecheville and **J. A. Leo Henderson**, mining engineers of London, and **J. B. Tyrrell**, of Toronto, are representing important British interests in the northern Alberta oil fields.

Viscount Tadashiro Inouye, of Tokyo, Japan, was the guest of honor at a lunch in Washington, D. C., recently given by **Dr. H. Foster Bain**, acting director of U. S. Bureau of Mines.

Hjalmar E. Skougar, consulting industrial engineer, of New York City, is making a protracted professional trip to England, Western Europe, and Scandinavia. He may also visit Russia.

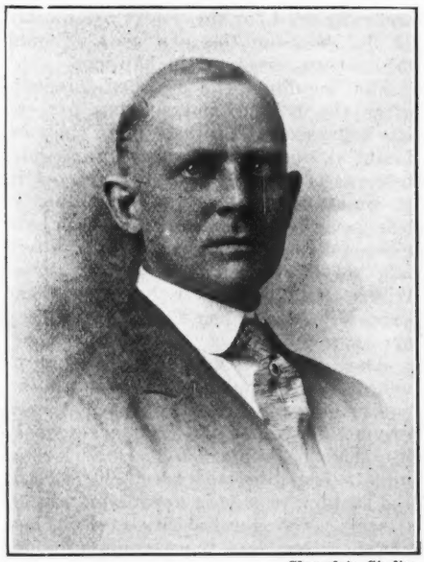
A. J. May has been appointed mine superintendent at the Tintic Standard mine, Eureka, Utah, to succeed **John Westerdahl**, recently killed during a "hold-up" of the company's store at Dividend, Utah.

Carl Brewer, of Hibbing, Minn., superintendent of the Boeing mine, a property of the Mesaba-Cliffs Iron Mining Co., left last week for an extended trip through the eastern states and a visit to New Haven, Conn.

L. W. Wallace, executive secretary of American Engineering Council, has been named to represent the Council on the U. S. Board of Surveys and Maps. Mr. Wallace succeeds **Alfred D. Flinn**, secretary of Engineering Foundation, in this assignment.

Frederick G. Clapp, petroleum engineer, of New York City, advises us that he is no longer connected with Petroleum Corporation of America, or the Pan-American Exploration Co., as was stated by mistake in our issue of March 12.

Mr. Clapp, who is a native of Boston, Mass., and a graduate in geology



Champlain Studios

FREDERICK G. CLAPP

of the Massachusetts Institute of Technology, began his technical work while a member of the U. S. Geological Survey from 1902 to 1908. In the latter year he resigned and started a professional practice which has eventually brought him first-hand knowledge of the oil and gas fields of the United States, Canada, Hungary, China, Mexico, Colombia, Haiti, Cuba, and Central America. The results of his field work form the subjects of many professional reports, several geologic folios, and a number of contributions to technical journals. They include a large two-volume report, "Petroleum and Natural Gas Resources of Canada," published in French and English editions by the Canadian Department of Mines in 1914-15 and 1917.

Since severing his connection with the Pan-American Exploration Co., in 1919, Mr. Clapp has been chief geologist of the Associated Petroleum Engineers. He is a member of many clubs and technical societies, including the Geological Society of America, and is on the oil and gas committee of the A. I. M. E.

Mining and metallurgical engineers recently visiting New York City included: **H. A. Wheeler**, St. Louis, Mo.; **H. H. Howry**, American Can Co., Maywood, Ill.; **George C. Westby**, of British America Nickel Corporation, Ottawa, Ont.; **Edwin C. Holden**, Davison Chemical Co., Baltimore, Md.; **Alan B. Sanger**, Boston, Mass.; **Knox Taylor**, of Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; **R. N. McBride**, Lore City, Ohio; **H. W. Edmondson**, of Rio Plata, Chihuahua, Mexico; **Joseph W. Ady, Jr.**, of Colorado Springs, Col.; and **Henry M. Schleicher**, 32 Thornton St., Roxbury, Boston, Mass.

OBITUARY

M. Lamborot, formerly mine superintendent at Liévin, and a graduate of Saint-Etienne of the class of 1847, died at Arras, France, about March 15. He was one of the deans of French engineering.

George W. Crismon, mining engineer, of Salt Lake City, Utah, died there on March 25, at the age of forty. He was a graduate of Utah Agricultural College and of the State University. He had a number of mining interests in Utah, notably the Utah mine, Fish Springs, and had been a member of Crismon & Nicholls, assayers, since graduation.

Byron Jackson died in San Francisco, Cal., March 28, at the age of eighty years. He founded and for a long time was identified with the company now known as the Byron Jackson Iron Works. Soon after the San Francisco fire of April 18, 1906, he disposed of his interests in the pump company. His name and the mine pumps produced by his company are familiar to many mining districts.

Charles Stead, of Eveleth, Minn., mining captain of the Oliver Iron Mining Co., in the Eveleth district of the Mesabi Range, died in Chicago on March 24. His health had been failing steadily and rapidly since early in February. Mr. Stead was born in Sweden in 1863, and came to the United States about 1890. He had worked for the same company for the last twenty-five years on the Mesabi Range, at Hibbing, Chisholm, and Eveleth.

C. Amory Stevens, of New York City, the largest individual mine owner in Grant County, N. M., died of pneumonia on March 21. He was also largely interested in holdings in Colorado and Virginia. Part of the present property of the Phelps Dodge Corporation at Tyrone, N. M., was purchased from Mr. Stevens. During the war a large tonnage of ferromanganese ore was shipped to the United States Steel Corporation from the Chloride Flat properties at Silver City, N. M., owned by him. Mr. Stevens was seventy-five years old.

THE MINING NEWS

LEADING EVENTS

Minerals Separation-Miami Case Up Again at Wilmington

Arguments Heard Re Admission of North American Corporation as Party to Suit—Miami Denies Subsidiary's Right

The case of Minerals Separation, Ltd., vs. Miami Copper Co. was again before the U. S. District Court at Wilmington, Del., on April 2, when arguments were heard as to the admission of Minerals Separation North American Corporation as a party plaintiff to the Miami suit. The testimony in this matter had been taken on Jan. 17, 1921. (See *Engineering and Mining Journal*, Jan. 29, 1921, p. 236.)

Minerals Separation contends that the Minerals Separation North American Corporation possesses only the equitable rights in the patents, and that Minerals Separation, Ltd., is still the owner of the legal title. Minerals Separation claims, therefore, that both Minerals Separation, Ltd., and Minerals Separation North American Corporation should properly be joined in the suit.

Miami Copper Co., on the other hand, contends that a certain agreement, dated July 8, 1913, was, in fact, a sale of the patents themselves, passing title out of Minerals Separation, Ltd., and that, therefore, Minerals Separation, Ltd., had no right to bring the original suit against the Miami Copper Co., and that Minerals Separation North American Corporation has no right to join in the suit now.

Though the question as to whether or not Minerals Separation North American Corporation should become a party plaintiff in the Miami suit, under ordinary circumstances, might seem to be relatively unimportant, it is thought by some connected with the Miami company that the result of this argument may be far reaching.

Should the court hold that the transaction of July 8, 1913, was a sale of all the right, title, and interest in the patents, and not merely of the equitable rights, it would establish the fact that Minerals Separation, Ltd., had no legal right to bring the Miami suit at the time it did, and that this suit should, therefore, be thrown out of court.

This would also affect seriously the "disclaimer" made by the Minerals Separation, Ltd., with respect to the three claims declared to be invalid by the Supreme Court in the Hyde case. All of the pending suits under Minerals Separation's principal patent would be influenced by such a decision. The decision will, therefore, be awaited with interest.

WEEKLY RÉSUMÉ

The flotation litigation of Minerals Separation, Ltd., vs. Miami Copper Co. was up again in court at Wilmington on April 2, when arguments were heard on the admission of the Minerals Separation North American Corporation as party plaintiff to the suit. In Denver the State Assembly committee appointed to investigate the affairs of the Colorado School of Mines has filed its report, in the main vindicating President Victor C. Alderson. The same Assembly has passed an act providing for the creation of a "metal mining fund," to aid the mining industry and to be raised by a tax of one-tenth of 1 per cent on all metalliferous property in the state. At Granite City, Ill., the new 500-ton blast furnace of the St. Louis Coke & Chemical Co. is now running successfully on Illinois coke; this operation is expected to encourage iron mining in Missouri, where the Iron Mountain and Pilot Knob properties are again shipping. From Washington, D. C., it is reported that the metal schedule of the tariff bill is ready to be reported by the subcommittee to the full committee. The metal-mining situation is essentially the same as last week, shutdowns already announced being effected as rapidly as possible. It is reported that gold operators at Porcupine, Ont., are speeding up, more power being available and labor more abundant.

American Smelting & Refining Co. Re-elects Officers

The new board of directors of the American Smelting & Refining Co. met on April 12 and organized for the ensuing year. The following retiring officers were re-elected:

Simon Guggenheim, president; Edgar L. Newhouse, chairman of the board; Francis H. Brownell, vice-president; C. W. Whitley, vice-president; William Loeb, Jr., vice-president; H. A. Guess, vice-president; H. A. Prosser, vice-president; Roger W. Straus, assistant to the president; John C. Emison, treasurer; Frank W. Hills, comptroller; Lucius A. Chapin, assistant comptroller and assistant treasurer; W. E. Merriss, secretary; R. P. Reese, auditor.

The following new members were added to the executive committee: Lyman Candee, member of the New York Board of Underwriters; E. C. Jameson, president of the Globe & Rutgers Fire Insurance Co.; Wilfred Shore, of the Irving National Bank; Frederick T. Walker, first agent Royal Bank of Canada, New York branch.

A 20 per cent cut in salaries of the executive force at all plants, effective May 1, has been announced. This will affect every executive from the president down, or 1,500 in all.

Aid for Mining in Colorado in Act Recently Passed

Creates Fund for Benefit of Industry by Levying 0.1 Per Cent Tax on All Metalliferous Property in State

A bill "To Create a Fund for the Benefit of the Metal Mining Industry," was enacted by the Colorado twenty-third General Assembly. It provides for the levy and collection of a tax of one-tenth of 1 per cent on the assessed valuation of all metalliferous mining property in the state. It creates a commission or board of nine members who are empowered to make such rules and regulations regarding the administration and expenditure of the fund as they shall deem proper.

The bill was sponsored by the Colorado Metal Mining Association, and its purpose was to establish an agency, adequately and equitably supported by the mine owners of the state, to supplement the work of the state organization; to do those things and to carry on such activities for the benefit of the industry, which, through lack of means or authority, the individual or voluntary organization could not do. The tax will, it is estimated, raise approximately $20,000 annually.

The board will be equipped to work out economic problems affecting the industry and is empowered to make investigations regarding the prospecting for, mining, transportation, buying, selling, or treatment of metalliferous ores, and such other investigations regarding the industry as the board may deem expedient or necessary.

The board appointed by the Governor consists of Bulkeley Wells, of Telluride, manager of the Smuggler Union; George M. Taylor, manager of the Portland Gold Mining Co. at Cripple Creek; Fred Carroll, manager of the Atlas Gold Mining Co. at Ouray; R. M. Henderson, of Breckenridge, manager of the Wellington Mines Co.; William Loach, manager of the Wolf Tongue Mining Co. at Boulder; Jesse F. McDonald, manager of the Down Town Mines Co. at Leadville; Charles Anderson, manager of the Smuggler Leasing Co. at Aspen; E. L. Young, manager of the Sunnyside Mining & Milling Co. at Eureka, and Charles E. Chase, of Denver, manager of the Liberty Bell, at Telluride. Bulkeley Wells was elected chairman of the board and M. B. Tomblin, secretary of the Colorado Metal Mining Association, was appointed secretary.

Though something new in mining legislation, the measure was solidly supported by the mining interests of the state, which find that individual

effort or voluntary organizations are no longer able to cope with the distressing conditions of the mining industry. The chief features of the bill are as follows:

"Section 1. Upon the passage of this act and annually thereafter, in addition to any tax now or hereafter assessed, there shall be levied and collected a tax equal to one-tenth of 1 per cent upon the assessed valuation of all producing and non-producing metalliferous mining property, including lode claims, placer and mill sites, together with the improvements thereon, all more particularly defined in sections 5618, 5621, and 5625 of the Revised Statutes of 1908. Said tax shall be assessed and levied by the county assessor in the regular manner and collected by the county treasurer with other taxes, and forwarded to the State Treasurer, who shall deposit the same in a fund to be known as the metal mining fund, which shall be kept separate and apart from all other funds of the state, to be used and disbursed in the manner hereinafter provided. The State Auditor is hereby authorized upon voucher issued by the chairman and secretary of the board of directors of the metal mining fund, and signed by the Governor, to draw warrants upon the State Treasurer who shall pay the same out of this fund in payment of obligations incurred under provisions of this act.

"Section 2. The metal mining fund shall be under the direction of the board of nine members, who shall be appointed as follows:

"Upon the passage of this act the Governor shall appoint nine persons, all of whom are engaged in metalliferous mining; three shall be appointed for the term of six years, three shall be appointed for a term of four years, three shall be appointed for a term of two years, and biennially thereafter the Governor shall appoint three persons to the term of six years. In the event of a vacancy occurring by death or resignation, the Governor shall appoint for the unexpired term. Upon the appointment of the said board, it shall proceed to organize by electing one of its members as chairman. A secretary shall be appointed by the board, whose duties shall be defined and compensation shall be fixed by the board. The office of the secretary shall be at the place designated by the board of directors.

"Section 3. It shall be the duty of the chairman of the board to preside at all meetings of the board, to call special meetings of the board whenever found necessary; provided, however, that not less than four regular meetings shall be held during each year, to sign all warrants calling for the expenditure of money and to perform such other duties as may be deemed necessary by the board.

"Section 4. Said board of directors shall make such rules and regulations regarding the administration and expenditure of the fund as they shall deem proper, providing they do not conflict with this act or other laws of the state. The board is authorized to make such investigations regarding the prospecting for, mining, production, transportation, buying, selling, treatment or reduction of metalliferous ores, as well as economic conditions relating thereto, and to make such investigations concerning the industry as they shall deem expedient or necessary. All departments of the state shall aid and assist the board in their investigations in every reasonable way, and its representatives shall have free and open access to the files and records of every state and county department. The board is authorized to employ such assistants as shall be needed and to fix the compensation thereof. All agents and employees of the board shall hold employment at the pleasure of the board and their term of service may be terminated at any time.

"Section 5. The directors of the metal mining fund shall receive no salary or emoluments whatsoever; providing however, that members of said board shall be paid their actual and necessary traveling expenses in attending the meetings of the board. Regular meeting of the board shall be held quarterly and at such other times as may be called by the chairman of the board. Any vacancies occurring in said board caused by resignation, absence from the state, death, or other causes, the unexpired term shall, upon notice from the board of directors, be filled by the Governor."

Preparing for Next Season's Work in Alaska

Yukon District Expected To Be Active—Miners Returning, Owing to Dull Times Elsewhere—Gold Reported Near Fairbanks

With the return of spring, the many Alaskan mining men wintering in Seattle are growing restless and anxious to return to the Northland. Many of them are busy making the final purchase of supplies for the coming season. The 1921 season of navigation between Seattle and Anchorage, Cool; Inlet, was opened on March 22 by the sailing of the steamship "Alameda." The large passenger list included fifty men for the Alaskan Engineering Commission, and a large part of the cargo was made up of supplies for the commission.

In the Yukon district the coming season is expected to be one of the busiest in many years. There will be extensive gold dredging and hydraulicking, and several new silver properties are being opened. Work has begun on a machine shop which will engage fifty men preparing dredges for Upper Dominion Creek, Gold Run Creek, and the Klondike Valley. Early in May this dredge fleet will be able to obtain hydro-electric power.

Many old timers who were unable to secure work during the unemployment period are returning to Dawson. Regular mail stages are coming through every week, drawn by four and six horses, bringing many passengers.

According to a report gold has been found on a small creek about twenty miles distant from Fairbanks. This area was prospected years ago, but it is said that the shafts then sunk were stopped at a false bedrock. Several months ago a number of prospectors resumed work along the creek and broke through the false bedrock, making a rich strike on the true bedrock. A report that the gravel is high-grade and the pay streak more than 50 ft. wide has caused a small stampede to the new workings.

Alderson Vindicated in Report to Colorado Assembly

President of Golden School Mildly Criticized—Trustees Censured for Loss of Rare Metals Station—Management Called Efficient

The committee appointed by the Colorado Twenty-third General Assembly to investigate the Colorado School of Mines filed its report with the Legislature on April 3. In the main, the report is a vindication of Dr. Alderson and the management of the school. Mild criticism is found in the statement that Dr. Alderson, president of the school, "is the storm center of criticism of the administration of the School of Mines" and that "the troubles are of so long standing and are affected by opinions and prejudices so varied and opposite that it makes it difficult to consider the evidence."

Referring to the action of the trustees resulting in the removal of the U. S. Bureau of Mines from Colorado, the report says: "Had proper diplomacy been exercised and a keen interest taken by the board of trustees and the mining men of the state, the removal of the Bureau of Mines from the state might have been avoided. We must remember that to a certain extent the Bureau of Mines was a guest of the State of Colorado, with the School of Mines acting as host, and every effort should have been made by the authorities of the state to have retained it, and suitable notice should have been given so concerted action might have been taken in the matter if found necessary."

In reference to the experimental ore-testing plant, the report says: "Since Dr. Alderson's return in 1917 there have been minor improvements and changes made (in the school experimental mill), but nothing to indicate that the proper interest in this mill was being taken by anyone."

Speaking of the trustees, the report says: "Instances have occurred where the board of trustees have failed to retain the services of faculty members without giving said members sufficient notice, and such action on the part of trustees is discourteous and tends to the demoralization of the school, and should be discontinued."

Recommendations were made as follows: "The committee believes, from the ideas and opinions of mining men that have come to it, that the purpose of the School of Mines is to assist in the development of the mining interests of the state, principally, and the oil industry, incidentally, and to that end we believe the efficiency of the school may best be advanced by having competent mining men on the board. There should be, in our judgment, at least three men on the board who are vitally interested in general mining and milling."

Unanimous approval was given to the proposed consolidation of the higher institutions of learning of the state, as suggested by House bill No. 364, by Mr. Reed.

The committee report groups the charges against the school under six headings, as follows:

1.—Trustees' interference with discipline. Finding: "The trustees did not overstep any propriety in assuming jurisdiction occasionally."

2.—President Parmalee should have been retained. Finding (quoting in part): "It rests within the province of the board to refuse to employ the president or any member of the faculty."

3.—Dismissal of faculty members without adequate notice or hearing. Finding (quoting in part): "Such action on the part of trustees is discourteous and tends to the demoralization of the school and should be discontinued."

4.—Lowering of standards of scholarship by President Alderson. Finding (quoting in part): "The committee has not been able to determine that such charge is true."

5.—Dr. Alderson used improper pressure to induce teachers to support his policies or further his personal interests. Finding: "No evidence to sustain this charge."

6.—Dr. Alderson has been guilty of plagiarism. Finding: "Insufficient evidence."

In summing up the evidence the report says: "The management and administration of the School of Mines is efficient; the trustees, officers and faculty are complete, well qualified and trustworthy; and the institution, members, officers, faculty, and trustees are entitled to the support, respect, and encouragement of the citizens of this state, the alumni of the institution, and the general public."

"Your committee is of the opinion that the institution will flourish and its excellent reputation be maintained if it receives the encouragement and patronage to which it is so justly entitled."

New Furnace at Granite City, Ill., Using Illinois Coke

The recently completed plant of the St. Louis Coke & Chemical Co. at Granite City, Ill., is now in successful operation. It consists of a 500-ton modern blast furnace and eighty byproduct coke ovens of the Roberts pattern that cost about $9,000,000. Each oven has a capacity of fifteen tons of coal, which comes mainly from Williamson County, Ill., to which is added some from Indiana or West Virginia. The quality of the coke is first class. Mesabi and Missouri iron ores are used and about 450 to 500 tons of pig iron is produced per day for the local market.

This is the first successful effort to use Illinois coke in blast-furnace practice, and is resulting in a large saving in freight over shipping in Connellsville coke or West Virginia coal. This plant will stimulate the reopening of some of the Missouri iron mines, and the old Iron Mountain and Pilot Knob mines have again entered the producing list.

Queensland Marketing Sapphire Output Through Rubin Brothers

New Agreement in Operation—State Leads New South Wales as Producer of Precious Stones

Brisbane, Feb. 21. — The agreement entered into between the Queensland government and Messrs. Rubin Brothers, of Bombay, Paris, and London, for the marketing of the sapphires produced in this state (see *Engineering and Mining Journal*, March 5, 1921, p. 441), has been put into working order, and the result so far indicates that it will at least give a much-needed stimulus to the industry. The 75 per cent of the value to be advanced to miners is not to be provided by the government, but by the firm selling the gems, but the state will control the scheme, and proclamations have already been issued under which the government acquires all sapphires produced in Queensland, so as to insure that Rubin Brothers will have the sale of all of them, or rather of the blue stones, as fancy stones are not included in the agreement.

A paragraph published in the *Mining and Scientific Press* of Jan. 1 regarding the gems of Australia is not only incorrect but unfair to Queensland. It is there stated that "New South Wales leads all other states in the variety and value of precious stones produced." The only precious stones officially recorded as having been produced in New South

A SAPPHIRE CLAIM, ANAKIE FIELD, QUEENSLAND, AUSTRALIA

Wales during 1919 were opal to the value of £27,550 and diamonds worth £1,700, or a total of £29,250. In the same year the Queensland sapphire field of Anakie, the best in the world, produced sapphires alone to the value of nearly £43,000 (over £64,000 in 1920). The same paragraph states that it is claimed that Lightning Ridge, in New South Wales, is the only part of the world known to produce black opal. Though it is true that Lightning Ridge may be said to have "made" the black opal owing to the quantity produced and to the beauty of the stones, it is an undoubted fact that equally beautiful black opals have been found from time to time in Queensland.

Queensland has, in its far western districts, vast areas that are opal-bearing, and the gems found there are, like those of the neighboring State of New South Wales, unsurpassed. At present, however, scarcely any opal is being won in the former state. Many years ago the product reached up to £30,000 a year. The opal fields of Queensland are under a great disability from their remoteness and from the fact that in times of drought there is no water for the prospector nor grass for his horse, and in good seasons the demand for labor in the western pastoral districts is so keen, and the wages paid are so enticing, that men do not then favor the uncertain occupation of opal mining. Most of the opal deposits as yet found have been obtained near the surface, and the depth of workings in late years has ranged from 15 to 20 ft. The opals are found in beds of sandstone, clay ironstone, and other sedimentary rocks belonging to the Desert Sandstone formation in the Upper Cretaceous. Some beautiful specimens known as "boulder opal" are found in nodules of clay ironstone imbedded in sandstone or clay.

On the Anakie field, in Queensland, the sapphires occur associated with corundum in old alluvial deposits. The field covers an area of about twenty square miles, and is within easy access of the Central Railway at a point 190 miles from Rockhampton, which is about 400 miles north of Brisbane. The corundum stones, which are usually less than an inch in diameter, are all distinct crystals, although more or less corroded by the basalt magma which once contained them. Crystals of coarse corundum have been found which contain sapphires in the center, and sometimes perfect gemstones are obtained in this way.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Tariff Schedule on Metals Is Ready

Subcommittee, However, Declines To Announce Details at Present, in View of Possible Changes

The metals schedule of the new tariff bill practically has been completed by the subcommittee composed of Representatives Tilson, of Connecticut; Mott, of New York, and Timberlake, of Colorado. The subcommittee declines to announce any of its conclusions, on the ground that they are likely to be changed by the full committee and that such announcement would give rise to renewed discussion which would serve no good purpose at this time. It is pointed out that the committee was unusually liberal in granting time to all interests during the period of the public hearings. Those interested still will have opportunity to present their views after the bill is in final form.

In the case of the metal schedule it is understood that the subcommittee could not follow the Payne-Aldrich rates as closely as is being done by the subcommittees working on some of the other schedules. This is due to the fact that the war gave rise to many fundamental changes which have a bearing on items in this schedule. In some cases there are no precedents in the Payne-Aldrich Act, and, as a consequence, the committee has nothing to show the effect upon industry.

It is believed that the subcommittee has recommended a low rate of duty on manganese, chrome and tungsten ores. It is known, however, that an effort will be made in the full committee to continue these ores on the free list.

Particularly strong pressure will be brought to secure some duty on manganese ore, because of the favorable showing which has been made in the development of the rhodochrosite ores in the Butte district. It is estimated that manganese from Butte can be laid down at Pittsburgh at around 60c. per unit. The comparatively low rate of duty thus would make it possible to compete with imported manganese at this principal center of consumption.

With regard to duty on tungsten ores the House already has passed a bill placing a duty of $10 per unit of tungstic trioxide contained in crude tungsten, ores and concentrates. This was amended by the Senate Finance Committee so as to read $9 per unit. As the situation has not changed greatly since the so-called emergency tariff bills were passed it is possible that the House may insist upon consistency of action and continue the schedules contained in these emergency bills. The House also approved at the last session a duty of one-half cent per pound on magnesite ore and a duty of one-fourth cent per pound on zinc ore containing more than 10 per cent and less than 20 per cent of zinc; one-half cent per pound on ore containing 20 per cent and less than 25 per cent of zinc, and one cent per pound on ore containing 25 per cent or more of zinc.

Ferromanganese and other alloys are causing a great deal of discussion in the committee. It may be said, however, that the request for a duty of two cents per pound on ferromanganese is not being considered favorably. It is expected that a duty of one cent per pound will be written into the bill.

It is known that the committee is applying specific, rather than ad valorem, rates wherever possible. There is marked difference of opinion as to whether American or foreign valuations should be employed.

Asbestos on Indian Reservations Now Open to Location

Claims Containing This Mineral Said To Have Been Filed on Already by Subterfuge

Asbestos deposits in the Fort Apache and San Carlos Indian reservations, in Arizona, now are open to location. This is made possible by the following clause in the Indian Appropriation Act:

"That wherever the term 'metalliferous' is used in Section 26 of the Indian Appropriation Act of 1919, it shall be defined and construed by the Secretary of the Interior to include magnesite, gypsum, limestone, and asbestos."

The original provision referred to, affecting the location of metalliferous deposits within these Indian reservations, reads in part as follows:

"Mining claims may be located by such citizens in the same manner as mining claims are located under the mining laws of the United States: Provided, That the locators of all such mining claims, or their heirs, successors, or assigns, shall have a preference right to apply to the Secretary of the Interior for a lease, under the terms and conditions of this section, within one year after the date of the location of any mining claim, and any such locator who shall fail to apply for a lease within one year from the date of location shall forfeit all rights to such mining claim: Provided, further, That duplicate copies of the location notice shall be filed within sixty days with the superintendent in charge of the reservation on which the mining claim is located, and that application for a lease under this section may be filed with such superintendent for transmission through official channels to the Secretary of the Interior."

It is understood that most of the

claims thought to contain asbestos had been located previously under the subterfuge of prospecting for iron. Considerable protest is reaching the Department of the Interior in this connection and it is not unlikely that an investigation will be made with the purpose of ascertaining if there has been discrimination against prospectors who were careful to observe the law with regard to operations on these Indian reservations.

Mental Hygiene in Industry Again To Be Studied

Plans for the resumption of research on mental hygiene in industry have been completed by T. T. Read, chief of the division of Education and Information of the U. S. Bureau of Mines. This work was started more than a year ago under the auspices of Engineering Foundation. The work was begun by the late Dr. Southard. Much difficulty was experienced in conducting this research because of objections to a study of the mental conditions found among the employees of any commercial plant. The very mention of a study of the mental state of employees aroused a high degree of resentment. This apparently insurmountable obstacle, however, has been removed by an arrangement to make these studies in connection with the rehabilitation work of the Federal Board for Vocational Education. The Federal board has some 65,000 ex-service men in training, of which 10 per cent are mental cases. This provides a large amount of clinical material.

The research also has been facilitated by the appointment of Dr. J. H. Barnes, Jr., as district psychiatrist of the Board for Vocational Education. Dr. Barnes is a member of Mr. Read's subcommittee on Mental Factors in Industry, of the American Institute of Mining and Metallurgical Engineers. Both Mr. Read and Dr. Barnes have had extended experience in the study of psychiatry in industry and under the favorable conditions now offered it is believed that much progress will be possible.

War Mineral Awards

Awards totaling $56,081.03 were recommended by the War Minerals Relief Commission during the week ended April 2. In the chrome claim of C. S. Maltby the payment of $42,158.92 was recommended. The amount claimed was $77,503.87. An award of $13,406.48 was recommended in the manganese claim of Woods, Huddart & Gunn. This was 78 per cent of the amount that had been claimed.

In the light of new evidence an award of $147.13 was made in the case of Joseph Sewell, whose claim had been disallowed previously. An additional $368.50 was allowed in the claim of Ott & Thompson. This brings the total award to 32 per cent of the amount originally claimed.

Government's Silver Purchases Nearly 47,000,000 Oz.

The total purchases of silver under the Pittman Act up to the close of business on April 2 was 46,862,456 fine ounces.

NEWS BY MINING DISTRICTS

Special London Letter

Spitzbergen Enterprise Reported To Be a Failure—Modder East Borrowing £400,000—Globe & Phoenix Ore Showing Improved—San Francisco Mines Report

BY W. A. DOMAN

London, March 29—Some time ago I referred to the Northern Exploration Co. and the disappointment it had proved. The annual report is now in issue, and shows the undertaking to be more or less of a failure. Hugo Stinnes endeavored to secure control of this Spitzbergen enterprise by lending money, but our Foreign Office raised objections, and the company has not been able to get sufficient working capital since. When the company was floated with a flourish of trumpets there were suggestions of coal, iron, marble, oil, copper, and zinc deposits to be worked. These suggestions remain, but so far as can be gathered only one of the coal deposits will pay. This is at Davis Harbor, where it is stated that 4,500,000 tons can be mined commercially. At present the necessary plant is not erected.

There is no money with which to develop the marble property, though the marble manager thinks it can be made a commercial proposition if sufficient capital is available and quarries are worked on up-to-date lines. The copper deposit does not seem to be payable, and the zinc blende deposit cannot be mined successfully. A syndicate was formed to prospect for oil on the company's property, but it does not intend to exercise the option. So another string is gone. The directors are endeavoring to raise money in other directions.

The Modderfontein East, which has no stamp battery erected on the mine, but which uses the plant formerly belonging to the Apex company, had developed so well that an extended program was planned, and the Simmer Deep-Jupiter reduction plant was acquired for £110,000, as mentioned last week. As this is several miles away, the expense of dismantling, removal, and re-erection will be considerable. An issue of £410,000 debentures falls due in July, so that additional funds are necessary beyond the present resources of about £200,000.

Conditions in the money market being unfavorable to raising new capital, the Central Mining & Investment Corporation has agreed to lend £400,000 on debentures at 8 per cent for eighteen months from July 1 next. The debentures are to carry the right of conversion into shares at par. Shareholders are to be given the opportunity of subscribing up to 75 per cent of the loan, and to have the option to convert. This will prove a satisfactory solution of the Modder East financial trouble. Milling will continue on the same scale as at present, the larger scheme of development being postponed.

Much interest centers upon the report of the Globe & Phoenix Gold Mining Co. for 1920. Various rumors circulated early last year hinted at the approaching exhaustion of the mine. That there was some basis for them is seen in the technical report, for during the first six or seven months of the year the results of development were not payable. Matters then began to mend, especially on the 14th and 15th levels, and good values have continued to the present time. The deepest levels are the 23d and 24th, and this is where interest is being reawakened. Satisfactory values are showing, and it is said that the Rhodesia Exploration directors are beginning to inquire where this orebody is worked.

The protracted action over the John Bull claims and the extra-lateral rights will be easily understood in America. Although in the courts the Globe & Phoenix won the case, litigation is not necessarily at an end, and in regard to developments at the 24th level the situation is interesting. The ore reserves are estimated at 93,852 tons, containing 145,321 oz., of a value of 84/-, or £610,348. These figures compare with 102,182 tons (175,691 oz. and £737,902 value at the end of 1919). It would seem that the old ore blocks have on stoping exceeded estimates. As much ore is locked up in pillars, there may be a cutting down presently of the monthly crushing rate.

The fall in the price of metals has hit the San Francisco Mines of Mexico hard, just when the corner seemed turned. For the year ended Sept. 30 last there was a profit of £33,000; now, with metals down, debenture and share holders are asked to make a further sacrifice. The former, in consideration of an increase from 6 per cent to 8 per cent in the rate of interest, both on

debentures and suspended coupons, and conversion rights on double the number of shares, are asked to sanction the further postponement of payment of interest until April 1, 1924, and of the beginning of redemption of principal until April 1, 1925. The capital is to be reorganized and shares are to be made of the nominal value of 10/—.

Consequently, debenture holders will have an option over 400,000 10/— shares, instead of 200,000 £1 shares. Shareholders in the writing down get share for share, i.e., one 10/— for one £1 share.

CANADA

Ontario

Porcupine Companies Speeding Up—Gold Strike Reported Near Pembroke

Porcupine—Power was turned on full on April 7, enabling the Hollinger, Dome mines and McIntyre greatly to increase the scope of their operations. The Hollinger mill, working close to capacity, treated 3,000 tons of ore. Miners are flocking into the camp, and the companies are doing their best to find housing accommodations for them.

The shareholders of the Porcupine-Keora on April 4 ratified the proposed sale of two claims to a new company capitalized at $3,000,000, in which the Keora will retain a two-thirds interest.

Pembroke—It is reported that gold has been discovered on the south branch of the Petawawa River, about eighteen miles from Pembroke, where the rock is of Huronian formation with quartz similar to that found in the Porcupine district. Surface showings are said in some cases to assay high. A large number of claims have been staked.

British Columbia

Trail—Ore received at the Consolidated smelter during the week ended March 31 totaled 10,999 tons, of which 784 tons came from the Blue Bell mine, at Riondel, and the remainder from company mines.

Grand Forks.—The Granby company's plant at this place will be completely closed by the end of this month, and will be in charge only of watchmen. All movable machinery has either been sold or removed to Anyox. H. S. Munro, general manager, stated that the plant is likely never to be operated by the Granby company again.

CALIFORNIA

Rumored U. S. Steel May Ship Products to Coast via Panama—Taxes Refunded to Mountain Copper and Balaklala

San Francisco — Superintendents of gold mines along the Mother Lode and from Grass Valley held a meeting on April 7 at the Plymouth mine, in Amador County.

At a meeting on March 28 at the office of W. J. Loring, Mr. Loring, John T. Burns, Fletcher Hamilton, Edwin Higgins, W. G. Devereaux, and others took steps to provide an appropriate mining exhibit for the national exposition of mines and mining equipment, to be held in conjunction with the convention of the American Mining Congress, Oct. 17-22, at Chicago.

Interest in the Legislature's activities is being centered about changes in the labor compensation laws. Senate bill No. 259, a recodification of the compensation act, promises to be a hard-fought battle between labor interests and employers. Increase in the compensation rate and other novel changes have roused the employers, and it is an open question whether this sixty-page bill will pass. Mining interests will be subjected to an increase estimated at over 30 per cent in existing compensation rates if the bill passes in its present form.

Rumors are current that the U. S. Steel Corporation proposes to establish a line of steamers to carry steel to the Pacific Coast via Panama. If this is true a lower price for steel on the Pacific Coast is likely. Again, efforts are being made to establish a steel industry on the coast, and this move on the part of the Steel Corporation would indicate that it intends to hold the coast market for steel products.

Shasta County—The Mountain Copper Co., Ltd., and the Balaklala Consolidated Copper Co. (First National Copper Co.) have succeeded through court action in having excessive taxes, paid under protest, returned, to the extent of $13,917.

Angels—Greater activity is reported in the Mother Lode counties. For the first time in three years prospectors are again at work.

Yreka—George Hansell and George Uhl, of San Francisco, have taken a lease on the Siskiyou Klondike placer mine near Yreka. This property, on Kiney Creek above Oak Bar, is a fully equipped hydraulic mine and as a producer dates back to the early 50's. Work will begin at once and additional equipment will be installed.

M. Dean and associates, of Yakima, Wash., have taken a lease on the Wacker or Spring Gulch group of quartz mines near Yreka. This company will be incorporated. Operations will be resumed and erection of a mill is under consideration.

Callahan—The Utah-California Gold Mining Co., of Salt Lake City, Utah, of which Henry Wade is president, has taken a trust deed on 504 acres of mining ground near Callahan, which includes such groups as the Bolder, Knox Port, Cummings, Ore Grande Summit, Buzz Saw, and Drummond, and 500 in. of water from Boulder Creek. The equipment is extensive and includes sawmills, power plant, and compressor plant. The company pays about $150,000, receives a three-fourths interest, and guarantees to spend $150,000 in development work within two years.

Gottville—The Morgan & Herzog cinnabar mine in the Gottville district has been bonded to W. A. Hutton, a local mining man. This property has been developed the last two years to a depth of 250 ft. by drifts which have cut a vein 20 ft. wide. The ore shows values as high as 10 per cent mercury and contains considerable free mercury, a characteristic of the cinnabar deposits in northern California and southern Oregon. The "quick" is seen in the bottom of the dump cars and all through the works, and any of the rich ore will give up a generous quantity on being struck a heavy blow.

NEVADA

Con. Virginia Made Notable Production Recently—Blue Horse, Near Goldfield, Giving Promise

Virginia City—Progress is reported in driving the main haulage tunnel of the United Comstock Mines Co. A storage battery locomotive has been purchased for use in the tunnel. To date about 1,200 ft., or approximately one-tenth of the entire distance, has been completed. The Con. Virginia milled 771 tons of $27.46 ore week before last, this being the largest production for a like period since the bonanza days of the Comstock. Most of the ore being mined at present is from the 2,250 level. In the Ophir the drift on the Hardy vein was driven ahead in low-grade quartz.

Tonopah — The Belmont reports active development on all levels from the 700 to the 1,400. This company, like all others in the district, is reworking old stopes with success, widening them out to obtain low-grade ore which was allowed to remain when high-grade was plentiful and the price of silver lower. In many cases stopes 10 ft. wide or less are being widened to 30 and 40 ft. and proving profitable.

The last dividend of the Tonopah Mining Co., payable April 21, brings the total dividend disbursements of that company to $14,975,000. This company is maintaining a production of 150 tons of ore per day. West End profits for March were $57,439, from 5,125 tons of West End ore and 441 tons of Jim Butler lease ore.

The Tonopah Extension is cutting a station at the 1,650 level of its McCane shaft. Production was 2,400 tons and development footage 281 during the last week.

Divide.—No favorable news has been forthcoming from the Tonopah Divide mine regarding conditions on lower levels. Drifting and crosscutting are being done on both the 800 and 1,000 levels; shaft sinking is soon to be started below the 1,000 level; 50 tons of $28 ore is being shipped daily.

The Divide Extension continues to ship, the last shipment running $104 per ton. Many of the smaller development properties are working, but no new discoveries of importance have been reported recently.

Pioche—Ore shipments from the Pioche district for the week ended March 31 totaled 1,345 tons. Virginia-Louise shipped 845 tons; Bristol 250, Combined Metals 145, and Black Metals 105.

Goldfield—The Blue Horse mine, forty-five miles east of Goldfield, is controlled by a group of San Francisco men, among whom are J. W. Plant, Roy H. Elliott, W. H. Bissell, and George K. Allen. Over $80,000 has been spent on development. A two-compartment shaft is being sunk, and the vein has been exposed by workings for a length of 1,500 ft. Encouraging shipments have been made. About $100,000 more is also to be spent.

ARIZONA

Activity in Union Pass District, in Mohave County, Attracting Attention

Union Pass — Considerable interest is being displayed in the Union Pass district, a gold section in the River Range of mountains about fifteen miles west of the halfway point on the Kingman-Chloride road. Steady and consistent development work has been going on at several properties for a number of years. The rather "pre-boom" activities have been brought on by the wonderful showing in the Katherine mine, coupled with a recent sensational strike at the Gold Chain property and the advent in the field of C. M. Miller, a well-known mining promoter, in whose interests twenty-one claims immediately surrounding the Katherine have been taken over. Six of these claims will be known as the Katherine Extension, and are held jointly with the Sutro interests, which are operating the Katherine. The new company plans to start work at once on this group. There has been a mild rush to the locality during the last ten days. Claims have been located for miles in all directions, even across the Colorado River in Nevada.

Underground development work is well under way at the Arabian property, recently taken over on option by the Arabian Development Co., financed in Los Angeles. C. D. Ridgeway is the engineer in charge.

The 300-ft. 60-deg. incline shaft and the two levels at the 100 and 300 have been cleaned up and thoroughly sampled. Machinery has been installed and is in running order. Two shifts with machine drills are driving north on the 100 and south on the 300.

Huron—W. W. Lytzen, mine superintendent for the Big Ledge Copper Co., recently reported that the Henrietta mine is now in condition to produce. Operation waits on improvement in the metal market and reduction in cost of supplies. Mineralization in the Henrietta vein in connection with its length indicates that ore should extend for 2,000 ft. or more before copper is the predominant mineral. Test runs on a small scale at the new mill indicate a ratio of concentration of 3 to 1 and a recovery of 95 per cent of the copper, 84 per cent of the silver, and 93 per cent of the gold.

COLORADO

Smuggler-Union Completes Building for Flotation Plant—Standard Chemical Resumes at Radium Ore Properties

Telluride—Shipments of concentrates for March were: Smuggler-Union, 57; Tomboy, 44; Liberty Bell, 13; total, 114.

The building which is to house the new flotation plant of the Smuggler-Union Mining Co. is completed, and the machinery is being installed. Ore from both the Smuggler-Union and Black Bear properties will be treated in this plant, the operation of which will involve the employment of about 100 additional men in the mines and mills.

Leadville—The Leadville Mines Development Co. is driving a development tunnel through Canterbury Hill, toward Big Evans Gulch. The first objective is the Rosedale shaft, where the tunnel will have a depth of 225 ft. The tunnel will continue thence to the Canterbury Hill shaft, where the depth will be 4,600 ft. New blacksmith shop and tool houses have been built. John C. Cortellini is manager.

The Western Zinc Oxide Co. has recently reopened its first unit, in which additional machinery has been installed. The second unit will not be started until business improves. The company is operating at about 50 per cent capacity.

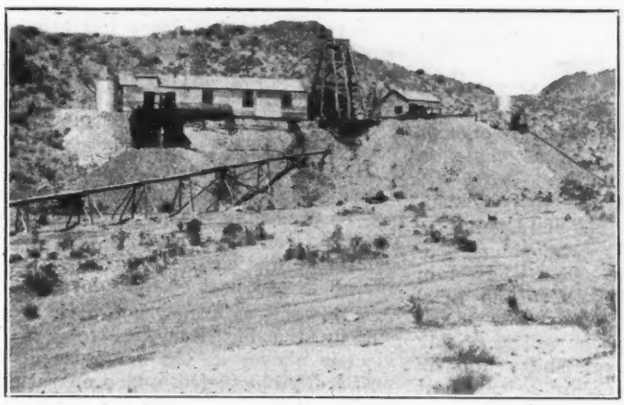
Montrose—The Standard Chemical Co. has recently resumed operations at its radium ore properties in western Montrose County. Over 100 men will be employed. J. I. Mullen is manager.

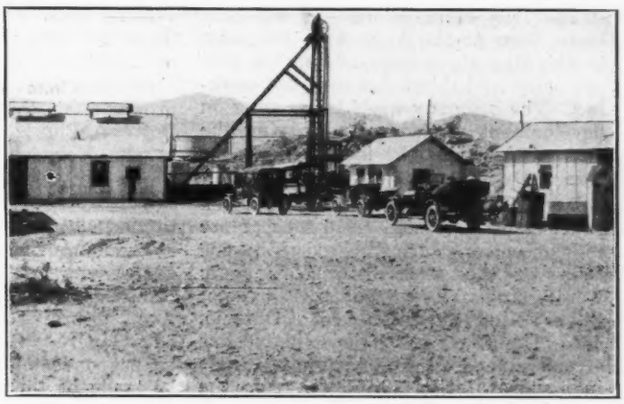
UTAH

Utah Copper Co. Planning To Aid Employees Laid Off—Garfield Smelter's Refusal of Dry Silver Ores Hurting Tintic District

Bingham—The Utah Copper Co. has thus far reduced its working force to about 700 men, and when the shutdown has been completed there will be left only about fifty men to act in the capacity of caretakers. The company will make no rental charge for cottages owned by it and occupied by former employees who have been unable to find work. Plans for the welfare of the men during the period of unemployment are being considered. One of these, which is thus far only in the tentative stage, is to use ten acres of ground for a community farm, to be worked by miners and mill hands, who will receive the produce. The larger part of the employees who have families will remain in camp at least until the close of the school season.

Working forces are being reduced at the Utah Consolidated, which for some time has been making no shipments.





LEFT—ARABIAN MINE PLANT; RIGHT—KATHERINE MINE, BOTH IN UNION PASS DISTRICT, MOHAVE COUNTY, ARIZ.

The mill of the Utah Consolidated is rapidly approaching completion but no attempt will be made to operate it at present, owing to the condition of the metal market.

The Utah Apex has been making no shipments for a considerable period, and has also suspended development work. The Utah Metal & Tunnel has stopped work. The United States Mining Co. is working 300 men at its mines, and sending about 350 tons of ore to its concentrator at Midvale daily.

Eureka—The lack of iron ore to mix with dry siliceous ores in the charge, which has followed the closing down of the Utah Copper Co., has caused the Garfield smelter of the A. S. & R. Co., which was receiving the Utah Copper concentrates, to refuse a considerable amount of the dry silver ores offered. A number of Tintic properties are effected, the principal ones being the Tintic Standard, the Eagle & Blue Bell, and Victoria. The lead smelters are unable to handle this class of silver ores at so favorable a rate as the copper smelters. The Victoria and the Eagle & Blue Bell have entirely sus-

pended shipments of siliceous ores, and are mining with reduced forces, shipping lead ore only.

Shipments from the Tintic district for the week ended April 1 totaled 150 cars, as compared with 174 cars the week preceding. Shippers were: Tintic Standard, 57 cars; Chief Consolidated, 25; Iron King, 17; Dragon, 9; Iron Blossom, 8; Eagle & Blue Bell, 7; Victoria, 5; Swansea, 4; Grand Central, 4; Centennial-Eureka, 3; Bullion Beck, 3; Gemini, 2; Mammoth, 2; Gold Chain, 2; Colorado, 1, and Sunbeam, 1. During the week the Chief Consolidated suspended work for two days, owing to an accident which occurred in No. 1 shaft, when mine cars which were being hoisted full of ore became wedged in between the cage and shaft timbers. Wall plates and shaft timbers were torn out, and it was necessary to chop the mine cars into small pieces so that they could be removed. The Tintic Drain Tunnel is completing the raise which is being driven near the face of its tunnel to furnish ventilation for the tunnel and preserve its timbers. The raise is up 500 ft. with 100 ft. more to go.

The Iron King, a part of which is under lease to the A. S. & R. company, is shipping three cars of fluxing iron ore daily, and thirty-five men are working. The company itself is carrying on development at depth, and paying the cost of this with the income from the iron ore.

Park City—Shipments for the week ended April 1 totaled 1,816 tons of ore and concentrates, as compared with 1,639 tons for the week before. Shippers were: Judge allied mines, 914 tons; Silver King Coalition, 463; Ontario, 438. The Silver King Consolidated has struck silver-lead ore of shipping grade in a raise started 13,575 ft. from the portal of the Thaynes Canon tunnel, which is being driven to develop new ground and to make connection with the California Comstock company's workings.

MONTANA

East Butte Continuing Production on One Shift at Pittsmont—Silver Butte Planning To Resume at Corbin

Butte—Preparations have been made by the Anaconda for a prolonged shutdown of its mines at Butte and its smelters. All the mules and horses have been hoisted and turned out to graze in the company's pastures near Georgetown, west of Anaconda. Only a force sufficient to man the pumps and keep the properties in repair is being maintained. Ore stocks at the Washoe Reduction Works are being cleaned up, and this plant will be closed. Operations will continue only at the wire works of the Anaconda at Great Falls, where the company is reported to be working on a wire order for the Western Union, which is said to total approximately 60,000,000 lbs.

Development and production are continuing at the Pittsmont properties of the East Butte company, although only one shift is working. It is necessary to maintain a certain output or else close down the smelter. With the treatment of the Davis-Daly ores from the Colorado in conjunction with its own it is possible to continue operating the reduction works. There is no intimation as yet of intention to suspend production along the lines followed by the Anaconda and the porphyries.

Drifting on orebodies with a view to increasing the reserves of the Colorado mine is proceeding satisfactorily, and more new ore was brought into sight in the last quarter than was mined. The new air shaft has been completed throughout, extending from the surface directly to the 1,800, thence by raises and crosscuts to the 2,700-ft. level, materially improving ventilation in the mine, in addition to making the Davis-Daly independent of the Anaconda for its air supply. Silver ores from the Hibernia are being shipped to the East Helena smelter of the American Smelting & Refinery Co.

North Butte is doing a small amount of development work at the Granite Mountain and Speculator.

Shaft sinking continues at Butte & Superior's Black Rock No. 3 shaft, with the 2,900 level the objective.

Crosscutting and sinking are in progress at the Plutus shaft of the Butte & Plutus, with the development of the Norwich and Plutus veins on the 400 level the objective.

Butte Western Silver Mines is continuing sinking from the 200 level.

Tuolumne Copper's development program will continue, with the Main Range shaft to be sunk to the 1,600 level, according to the company's local office. Ore production will probably be suspended, although shipments can be made of the silver ore to the East Helena smelter. The shaft is now past the 1,500, and the Spread Delight vein should be cut on the 1,600 within sixty days.

Lessees are shipping regularly from the Butte New England property, which lies to the south of the Davis-Daly's Colorado mine.

Lump Gulch District. — Operations have been suspended at the Liverpool property. Considerable development was done, and ore shipped from the 700 level. Deeper development is thought necessary, and until mining in general shows a revival operations will be halted.

Corbin District.—Plans are taking shape for the operation of the Silver Butte's property in the Corbin district, in addition to resuming work at the old Ballaklava mine, in the Butte district. The company officials are said to be thinking of taking over certain property near Bozeman.

Helena. — Announcement has been made that the East Helena smelter of the A. S. & R. Co. will continue to treat gold, silver, and lead ores. Representatives of the company are in the Butte district and in near-by camps in quest of silver ores.

MINNESOTA

Mesabi Range

Meriden Iron Co. To Drain Syracuse Lake

Aurora—Plans are being drawn by the Meriden Iron Co., for draining Syracuse Lake in Sect. 5, Tp. 58, R. 15. The lake overlies an orebody of about 3,000,000 tons, but the adjacent acreage contains a large tonnage, and it is imperative to drain the lake before any of the ore can be extracted. The project will call for several dams, will be a large undertaking, and will benefit not only the new property but some of the adjacent mines, which have found it hard to operate owing to the water conditions. The ore underlying the lake proper is the property of the State under the law.

Tower—The report of the drilling being done by the Scott-Bevier Iron Mining Co. on its lease is favorable. An orebody has been outlined, but drilling is to be continued.

The No. 8 incline shaft of the Soudan mine, a property of the Oliver Iron Mining Co., is being sunk 200 ft. further to facilitate mining.

Grand Rapids—A lease has been issued to the Tod Stambaugh Co. on a tract of land northwest of Grand Rapids which contains a considerable tonnage of washable ore. A washing plant may be erected soon.

Hibbing—The Boeing mine, of the Mesaba-Cliffs Iron Mining Co., is now on a producing basis. Development work on the main level is practically completed and slicing is in progress in the northwest part of the mine.

Nashwauk—The new approach being cut by the big Bucyrus No. 225 B electric shovel at the La Rue pit is practically completed, and preparations are being made to equip the shovel for dragline work. When equipped, the shovel will operate as a dragline machine on additional stripping for the enlargement of the pit.

MICHIGAN

The Copper Country

Quincy Curtails to 25 Per Cent Normal Following Recent Wage Cut

Houghton—The Quincy Mining Co. will begin at once to operate on a four-day-per-week basis, which will curtail operations to 25 per cent of normal. The company has announced a general reduction in all wages and salaries of 10 per cent, effective from April 1. In the same notice the management urged every employee to increase the efficiency of his labor to the highest point, so that the mine might be able to come through this depressed condition of the metal market without closing down entirely. It was also decided to discontinue the night shift at No. 6 shaft.

Calumet & Hecla has announced a 25 per cent cut in the wages of those still on the payroll, effective April 16. This includes pump men and mill, smelter, and power-plant employees.

THE MARKET REPORT

Daily Prices of Metals

April	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
7	12.50	28.25	29.50	4.25@4.40	4.25	4.65
8	12.50	28.25	29.50	4.25@4.40	4.25	4.65
9	12.50	28.25	29.50	4.25@4.40	4.25	4.60@4.65
11	12.50	28.50	30.00	4.25@4.50	4.25	4.60
12	12.50	28.50	29.75	4.25@4.50	4.25	4.60
13	12.50	28.00	29.25	4.25@4.50	4.25	4.60

*These prices correspond to the following quotations for copper, "delivered": 12.75c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
7	69	68¾	72½	158½	161½	20½	20⅝	25	26½
8	69	69	72½	159½	163	20½	20⅞	25⅜	26⅜
9	...	...	...	....	.....	...	...	...	...
11	69¼	69¼	72½	163	165¾	20¾	21¼	25¾	27
12	69	69⅜	72½	161½	165	20⅞	21½	25⅝	26⅞
13	69	69⅛	72½	157	161	20¾	21⅜	25½	26½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

April	Sterling Exchange	Silver			Apr.	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
7	391¾	99½	58⅛	33½	11	391½	99½	59⅛	34½
8	389½	99½	57⅝	33⅜	12	391	99½	62⅞	36½
9	389¼	99½	58⅛	33⅜	13	389	99½	59⅞	34⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Metal Markets

New York, April 13, 1921

General conditions in the metal trade are unaltered. Buying continues to be purely for immediate requirements, which are extremely small, and price changes are narrow.

Copper

The copper market has been exceedingly quiet, with practically no sales. The larger producers are quoting 12.75 @13c. for prompt shipment, and one or two thousand tons was probably sold at the lower figure on the 7th, 8th, and 9th. Beginning with Monday, however, most of this business seems to have died away. Some Michigan copper is reported to be offered for shipment from Buffalo at 12.50c. delivered, and we have also heard of business at 12⅝c. delivered. We do not consider that these sales represent any actual recession in the market, however, as practically all producers are adhering to the 12.75c. delivered price or better, and business done at less than that figure is carried on under exceptional circumstances. Export demand, both through the Copper Export Association and through individual agencies, has been practically nil.

Lead

The American Smelting & Refining Co. continues to quote lead at 4.25c., New York and St. Louis, and is reported to be freely offering prompt metal to consumers at this price. The outside market in New York is higher, and prices as high as 4.50c. have been paid during the last two or three days, especially where slightly later deliveries have been desired. The market has not been an active one, though. In St. Louis prompt lead is being freely offered, by practically all interests handling desilverized lead, at 4.25c., and it is altogether likely that this figure would be shaded slightly on desirable business. Chemical lead commands 10 to 15 points premium.

Two weeks ago in these columns we mentioned the offering of Spanish lead in the New York market. Of the 2,000 tons to be shipped here for taking care of small orders, half has already been received and the remainder is said to be afloat. In addition, it now develops that a large American lead consumer has purchased 5,000 tons of this Spanish lead. The details have not been made public, but we surmise that shipment is to be immediate and that the price paid was about £19 5s., which would be the equivalent of about 4.25c., New York, after all expenses have been allowed. This would indicate that this particular consumer, who follows the market closely, does not feel that present prices are likely to recede in the next few months, and also that no large tonnage could be secured in this country at the present A. S. & R. price. The question of the valuation of this lead for customs purposes has also been discussed. The best opinion seems to be that the proposed plan of basing the duty on the American valuation is unlikely to go into effect, at least not soon. In the Fordney tariff bill, which was again introduced in the House yesterday, this provision was omitted in favor of a scheme for a quarterly valuation of foreign exchange by the Director of the Mint, this valuation being used in connection with the foreign price for determing the duty. However, a depreciation of foreign exchange greater than 66⅔ per cent may not be set, so if this bill becomes a law, importations from Germany apparently would be discriminated against.

Zinc

The market has softened slightly, and prices have declined five points to 4.60c., East St. Louis. As usual, the decline was accompanied by a drop in demand, and sales have been disappointingly small. At the lower level of the market, producers are loath to interest themselves in selling the metal, feeling that they cannot lose by holding it longer. They are furthermore indisposed to make future offers, their reluctance being due to the thought of a possible improvement in the market. Consumers seem well supplied. The drop in steel prices has had no appre-

ciable effect on the market. The demand for zinc pigments seems to have improved somewhat. High-grade zinc sold during the week at 6.75@7c. per lb.

Tin

All grades have been dull, with price changes narrow. Tin is becoming the object of little interest in this country among dealers, and practically all the business is being done by large houses with international connections. These are only willing to sell at the price for which they can make replacements.

Straits tin for future delivery: April 7th, 29.25@29.75c.; 8th, 29.25@29.75c.; 9th, 29.25@29.75c.; 11th, 29.50@30c.; 12th, 29.50@29.75c.; 13th, 29@29.25c.

Arrivals of tin, in long tons: April 9th, Straits, 290; China, 5.

Silver

During the latter part of the week ending April 9, small buying orders for China account came into the market, with the result that some business was done for Frisco delivery. The London and New York markets continued quiet until April 12, when buying by China and the Indian bazaars jumped the price to 36½d. in London and 62⅞c. in New York. This sharp advance brought out additional offerings of silver, and as China and the Indian bazaars turned sellers on the rise, the price broke again on April 13. The market closes uncertain.

Mexican Dollars—April 7th, 44½; 8th, 44½; 9th, 44½; 11th, 45⅝; 12th, 48; 13th, 45⅝.

Gold

Gold in London: April 7th, 104s. 7d.; 8th, 104s. 11d.; 11th, 104s. 10d.; 12th, 104s. 10d.; 13th, 105s. 1d.

Foreign Exchange

European exchanges have held steady, with lire continuing to gain strength, owing to silk purchases and speculation. South American money has been much depreciated recently, the Argentina peso being quoted on Tuesday, April 12, at 32.625c., compared to par, 42.44c.; the Chilean peso, 13c., compared to par, 36.5c.; and the Brazilian milreis 13.5c., compared to par, 43.45c. Francs were 7.08c.; marks, 1.62c.; and lire, 4.595c. New York funds in Montreal, 12½ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—List prices of 28@28.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid.

Antimony—Chinese and Japanese brands, 5½c.; market dull. W.C.C. brand, 5¾@6c. per lb. Cookson's "C" grade, spot, 9⅜c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb. Demand light, with heavy supplies available.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Bismuth—$1.50@$1.65 per lb., 500-lb. lots.

Cadmium—Nominal, $1@$1.10 per lb., in 1,000-lb. lots. Price reduced as a reflection of London drop. Smaller quantities, $1.10@$1.25 per lb.

Cobalt—Metal, $4 per lb.; black oxide, $3@$3.10 per lb. in bbls.; sulphate, $1.35 per lb. in bbls.

Iridium—Nominal, $250@$300 per oz.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 38@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, $70@$80 per troy oz.

Palladium—$65@$70 per oz.

Platinum—$72@$75 per oz. Market has stronger undertone.

Quicksilver—Nominally, $44@$46 per 75-lb. flask. San Francisco wires, $46.

[1]**Rhodium**—$200@$225 per troy oz.

Ruthenium—$175@$200 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr_2O_3 foreign ore with a maximum of 6 per cent silica, 45@50c. per long ton unit, f.o.b. Atlantic ports.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $7.45; Mesabi bessemer, 55 per cent iron, $7.20; Old Range non-bessemer, 51½ per cent iron, $6.70; Mesabi non-bessemer, 51½ per cent iron, $6.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5.80; old bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; new bed low phosphorus, 65 per cent, $9.50.

Manganese Ore—30c. per unit, seaport; chemical ore (MnO_2) $60 per gross ton, lump; $70@$75 per net ton, powdered. Market dull.

Molybdenum Ore—85 per cent MoS_2, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3, $3@$3.25, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1.50 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York.

[1]**Zircon**—Washed, iron free, 3c. per lb.

[1]**Zirkite**—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., April 9—Zinc blende, per ton, high $24.80; basis 60 per cent zinc, premium, $22.50; Prime Western, $22.50; fines and slimes, $21@$20; average settling prices, all grades of zinc, $22.49.

Lead, high, $44.20; basis 80 per cent lead, $45@$47.50; average settling price, all grades of lead, $42.47 per ton.

Shipments for the week: Blende, 5,397, lead, 1,683 tons. Value, all ores the week, $192,850.

Buyers manage to secure a little over 5,000 tons of blende each week without advancing prices, but they would take more if sellers would let them have it.

Lead was advanced $5 per ton this week, with increased demand.

Platteville, Wis., April 9—No market for zinc or lead. Mining condition unchanged. Shipments for the week: Blende, 514 tons. Shipments for the year: Blende, 10,829; lead ore, 550 tons. Shipped during the week to separating plants, 664 tons.

Non-Metallic Minerals

Asbestos — Crude, No. 1, $2,000@$3,000; No. 2, $1,400@$2,000; spinning fibres, $400@$1,000; magnesia and compressed sheet fibres, $325@$500; shingle stock, $110@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7 per long ton, f.o.b. Cartersville, Ga. Small lots as low as $5.

Bauxite—High-grade French bauxite, $8@$10 per ton, Atlantic ports. American quotations the same. Consumers generally well supplied. Prices vary according to grade.

Chalk—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $8@$10; washed, $10@$12; powdered, $15@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $15@$20, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $15@$25, f.o.b. American ports; powdered, $35@$45, f.o.b. New York.

Feldspar—Crude, $8@$14 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $27@$30, car lots, f.o.b. Baltimore; ground, $17@$21, f.o.b. North Carolina points; $17@$21 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20 per ton, f.o.b. Illinois mines, and $20 f.o.b. Kentucky; ground, suitable for acid, chemical or enameling purposes, $60; lump, $17.50, f.o.b. Heathden, N. M. Ground, acid grade, 97 per cent CaF_2, $32, New Mexico. Canadian price generally $18 (Canadian currency) per ton, f.o.b. mines.

Fuller's Earth—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pa. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

Graphite—Ceylon lump, first quality, 7½@8c. per lb.; chip, 6@6½c.; dust, 4@4½c. No. 1 flake, 7c.; amorphous crude, ⅔c.@2¾c.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$2 per net ton; 1½ in., $1.50@$2. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined—Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $56 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $38 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $55@$60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.) High freight rates retarding business. Steamers quoting $8, Pacific to Atlantic ports.

Mica—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, quoted $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $12.50; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $7.35; 68 per cent, $6.85; 68@66 per cent, $6.60.

[1]Foote Mineral Co., Philadelphia, Pa.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 14c., c.i.f. Atlantic seaport; furnace size, 14c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 12 @ 14c.

Quartz—(Acid tower) fist to head, $10; 1½ to 2 in., $14; rice, $17; all net ton, f.o.b. Baltimore; lump, carload lots, $5@$7.50 net ton, f.o.b. North Carolina mines.

Sulphur—$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$18; all f.o.b. Vermont. California talc, $18@$40, talcum powder grade. Southern talc, powdered, carload lots, $10@$14 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

Mineral Products

Arsenic — White arsenic, 8@9c. per lb. in carload lots.

Sodium Nitrate — $2.60 @ $2.75 per cwt. ex vessel, Atlantic ports. Market quiet.

Sodium Sulphate—For 95 per cent material, $20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; $32@$33 per ton, New York.

Potassium Sulphate—Domestic, $215@$220 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 16@17c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $85@$90, f.o.b. furnace; resale, $90, delivered; English, $90@$95, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $32, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $50@$55; 50 per cent, $85@$90; 75 per cent, $145@$150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 54@58c. per lb. of contained tungsten. f.o.b. works. Foreign, 50c. duty paid f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—Basis 30 to 40 per cent, $5 per lb. of V contained, plus 75c.@$2 differentials and according to silicon content, f.o.b. works.

Metal Products

Copper Sheets—Current New York list price, 20@20½c. per lb.; wire, 15c.

Lead Sheets—Full lead sheets, 7½c.; cut lead sheets, 7¾c. in quantity, mill lots.

Nickel Silver — 33½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets 18½c.; sheathing, 17½c.; rods, ⅝ to 3 in., 15½c.

Zinc Sheets—$11 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, $160 per 1,000, f.o.b. Pittsburgh.

Chrome Cement—40@45 per cent Cr_2O_3, $45@$50 per net ton, and $55 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, $80 per net ton, shipping point; arches, keys, wedges, $85; splits, soaps, $100.

Fire Brick—First quality, 9-in. shapes, $55@$60 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $45@$50.

Magnesite Brick—9-in. straights, $90@$100 per net ton; 9-in. arches, wedges and keys, $105; soaps and splits, $120.

Silica Brick—9-in., per 1,000: $45@$55 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, April 12, 1921

Operating rates of the Steel Corporation and the independent steel producers are approaching uniformity. The Steel Corporation's operations continue to decrease, a guess for this week being an ingot production about 40 per cent of capacity, whereas independent operations are increasing slightly. Practically all reports of late have underestimated the independent production, which is probably slightly above 30 per cent at the present time, though some trade estimates have run as low as 15 per cent.

Pig Iron—Merchant pig-iron production is still lighter. Consumers' stocks are not exhausted, and there remain stocks at many merchant furnaces, including many that are out of blast, and not a few of the steel works have large stocks of basic iron, some of this iron being for sale. Prices are largely nominal, at $25, Valley, for bessemer, malleable, and foundry, and $23 for basic.

Steel Corporation Tonnage — The Steel Corporation's unfilled obligations decreased 649,102 tons in March, or about the average of several months preceding, but shipments were so much lighter that it appears that scarcely any new business was booked during the month. Unfilled tonnage remaining March 31 was 6,284,765 tons.

Coke

Connellsville—Furnace, $4@$5; foundry, $5@$6.

Policies of the Copper Companies

Largest Producers Have Shut Down, but Some Smaller Companies Continue To Operate—Production Cut More Than Half—Many Industries Affected—Export Trade Improving—Some Operators Now Bettering Their Position

THE LOGICAL METHOD of countering the blow of below-cost-of-production prices, ceasing production, is being followed by farmers and miners, whose industrial existence has been disturbed through the world-wide deflation in prices. Cotton growers have met the issue by decreasing acreage, and the copper producer has cut production. During months of threatened action much was said about abandoning operations, though relatively little was accomplished to this end, but the copper companies have finally translated words into deeds. Virtually all the large copper mines of the country are now shut down, and many of the smaller ones. The disheartening conditions under which producers have been operating for a year or more, the steady decline in the price of the metal to an abnormally low figure, and the piling up of a huge surplus are briefly the well-known underlying causes of this situation.

Some hope was expressed in February, after the financing of the copper surplus, that at least a psychological improvement in the market would ensue, possibly sufficient to ward off the necessity of the serious step the producers have now taken. Psychological effects upon the market are evidently confined to a subordinate rôle as market influences, for no noticeable improvement followed the execution of the financial arrangements. Producers were left in practically the same position as before, but with some benefit in the resultant easing of financial pressure.

The half-way measures of the copper operators in advocating a reduction in output, but reluctantly following their plans with not more than a small cut, have given way to sterner discipline. Practically over night, domestic production has dropped about 90,000,000 lb. monthly, to 45,000,000 lb., with excellent possibilities for further decreases, particularly by smaller copper operators who have not yet announced suspension but who are expected to follow suit.

The leaders in the movement to stop pouring copper on a saturated market were the four porphyry coppers, Utah, Ray Consolidated, Chino, and Nevada Consolidated, and the Phelps Dodge Corporation and the Anaconda Copper Mining Co., which, together with Calumet & Hecla Mining Co. (subsidiaries included) and Old Dominion Copper Co., have decided temporarily to cease productive operations. The following is a list of copper companies intending to abandon production by May 1 and an estimate of the effect on present production:

	Lb.		Lb.
Anaconda	10,000,000	Chino	3,000,000
Utah	7,500,000	Nevada Cons.	3,000,000
Calumet & Hecla	7,400,000	Old Dominion	2,200,000
Phelps Dodge	6,000,000	Inspiration	4,500,000
Ray Cons.	3,000,000		
Total			46,600,000

Well over half the current copper production is thus accounted for by these copper companies, the remainder coming from smaller companies, some of which have costs low enough to operate profitably. It is noticeable that a few of the companies that intend to continue, notably Calumet & Arizona, and Miami Copper, are not weighed down with heavy surplus stocks and have sold their copper regularly in the market—to their evident advantage. Their individualistic stand at present is prompted no doubt by their favorable financial condition and by the prospect of high precious-metal credits in reducing costs.

The effect of the shutdown in the country's leading copper districts is not confined to the visible and immediate reduction in copper output. Unemployment in Butte, Calumet, or Bisbee, wherever it occurs, lowers the purchasing power of the community and disturbs retail trade generally. Railroad companies are heavy financial losers, as the revenue derived from the freight on copper, fluxes, fuel, and the thousand and one other items which are required by a smoothly running copper-producing community is an important element in profitable operation. It is not difficult to picture the predicament of a railroad such as the Southern Pacific, serving the copper territory of Arizona, the leading copper-producing state in the Union. Incidentally, the silver production of the United States will decline through the withdrawal of much byproduct silver.

Some of the disadvantages have been enumerated. On the other hand, absolute curtailment is the only card left for copper producers to play with any prospect of scoring against the tremendous stock of surplus and unconsumed copper on hand. There is available at the present time close to a billion pounds of copper, generally produced at a cost far above the level of the market. A heavy loss would be entailed were this surplus stock to be marketed under present conditions.

The copper producers have followed in the steps of the zinc companies, which curtailed operations heavily last fall and winter. Unfortunately for the zinc industry, no improvement in zinc prices followed, but the producers were placed in a much better position than if production had been continued.

Export business has shown a decided betterment since the first of the year. The following table gives the movements of copper to and from the United States for fourteen months ended with February, 1921, from which it can be seen that the last four months of 1920 were disappointing in the net results of copper movements. November and December shipments into the United States only slightly overbalanced exports. Foreign trade in copper has improved recently, and for February—the last month for which statistics are available—a surplus export balance of over 21,000,000 lb. is indicated.

Despite the political difficulties in which Germany is enmeshed, a surprisingly large proportion of export copper has been moving to that country, and greater support has been consistently given to our copper market by Germany than by any other country during the last four months. Whereas the American copper imported by France and the United Kingdom is largely financed through liberal credit arrangements, Germany is largely paying cash, another peculiar feature of present copper movements.

COPPER MOVEMENTS IN 1920—1921
(In Pounds)

1920	Total Exports	Exports to Germany	Total Imports	Excess Exports
Jan.	49,684,000	.....	37,963,000	11,721,000
Feb.	57,595,000	.....	45,227,000	12,368,000
Mar.	88,035,000	10,661,000	39,144,000	48,891,000
April	64,395,000	14,003,000	27,812,000	36,583,000
May	82,792,000	7,055,000	53,861,000	28,931,000
June	57,986,000	11,415,000	51,530,000	6,456,000
July	46,869,000	5,635,000	30,491,000	16,378,000
Aug.	45,859,000	4,808,000	31,361,000	14,498,000
Sept.	24,455,000	1,536,000	30,562,000	— 6,107,000
Oct.	23,302,000	3,263,000	34,187,000	—10,885,000
Nov.	38,561,000	6,347,000	38,292,000	269,000
Dec.	41,840,000	10,737,000	40,942,000	898,000
1921				
Jan.	54,857,000	18,802,000	39,770,000	15,087,000
Feb.	62,480,000	.....	40,637,000	21,843,000

Although there is no immediate improvement in sight for copper prices, either through an increased domestic or foreign demand, when a turn for the better does come the huge surplus stocks may disappear sooner than is generally supposed, and the condition of one of the country's greatest industries should return quickly to its normally prosperous status.

COMPANY REPORTS

American Zinc, Lead & Smelting Reports Deficit

The annual report of the American Zinc, Lead & Smelting Co. for 1920 states that losses from operations amounted to $92,409.20. Interest on bonds totaled $39,625.22, giving a total loss of $132,034.42. Surplus on Dec. 31, 1919, was $3,695,151.89. Deducting depreciation and dividends totaling $885,922.26 ($482,037 on the preferred stock and $403,885.26 for reserves), left a surplus of $2,677,195.21 on Dec. 31, 1920. A consolidated balance sheet follows:

ASSETS

Property account		$12,516,518.19
Investments		1,369,192.79
Cash in sinking fund		5,337.05
Current assets		
Ore stocks	$592,398.94	
Spelter, pig lead, zinc oxide and sulphuric-acid stocks	643,883.01	
Inventories of materials	1,021,090.13	
Cash	354,944.16	
Notes receivable	54,238.43	
Accounts receivable	617,456.76	
Advance to Wisconsin Zinc Co.	13,000.00	3,297,011.43
Deferred charges to operations		66,561.17
Total		$17,254,620.63

LIABILITIES

	Shares	Par Value	
Capital stock issued			
Preferred stock	96,560	$25.00	$2,414,000.00
Common stock	193,120	25.00	4,828,000.00
Total			$7,242,000.00
First mortgage 5 per cent, ten-year gold bonds			1,481,700.00
Reserves for depletion, depreciation, etc.			5,464,201.03
Current liabilities			
Accounts payable		$258,856.71	
Interest accrued		6,173.75	
Taxes accrued		31,839.76	
Drafts in transit		82,637.14	379,507.36
Insurance reserve fund			10,017.03
Surplus			2,677,195.21
Total			$17,254,620.63

Callahan Zinc-Lead Co.

A report of operations of the Callahan Zinc-Lead Co. for 1920 states that 128,781 tons of ore was milled, having a metal content of 332,650 oz. of silver, 18,991,830 lb. of lead, and 38,100,000 lb. of zinc. Shipments of zinc were 29,845,344 lb., containing 2,047,388 lb. of lead. Net profit from operations amounted to $266,247.73, according to the statement:

INCOME

Net value of shipments	$1,411,543.71	
Miscellaneous income	12,986.35	
Total income		$1,424,530.06

EXPENDITURES

Mining, milling, and royalties	$1,078,157.59	
Administration and general expenses	50,159.65	
Cost of maintenance and development during period of shutdown	21,937.34	
Miscellaneous items	8,027.75	
Total expenditures		$1,158,282.33
Operating profit for the year before providing for depreciation or depletion		266,247.73
Cash proceeds of sale of treasury stock	$154,700.00	
Proceeds of sale of other mining companies' stock	16,362.10	171,062.10
Total		$437,309.83
Current surplus, Jan. 1, 1920		618,630.14
		$1,055,939.97
Deductions from current surplus during the year:		
Sundry expense applying to prior years	$7,691.89	
Improvements to mine and equipment	11,086.90	
Invested in other mining claims	2,500.00	
Cash distributed to stockholders from depletion reserve	755,606.00	
Total deductions		776,884.79
Current surplus at Dec. 31, 1920		$279,055.18

The company paid $2 a share dividends on 385,773 shares of $10 each. Operations ceased Oct. 31, 1920.

Calumet & Hecla Current Assets Decrease

The report of operations of the Calumet & Hecla Mining Co. for 1920 indicates that 57,627,883 lb. of copper was produced, at a cost of 20.73c. per lb.; 32,449,559 lb. was on hand Jan. 1, 1920, valued at 19c.; 43,019,141 lb., valued at 19.43c., was delivered during the year at 18.76c. per lb. Earnings statement follows:

Received for copper, delivered (18.76c.)	$8,069,949.71
Cost of copper, delivered (19.98c.)	8,596,001.49
Loss on copper (1.22c.)	$526,051.78
Loss by reduction of copper to market value (13c.)	3,635,780.81
Total	$4,161,832.59
Miscellaneous receipts, net	338,089.41
Net loss	$3,823,743.18
Dividends paid	500,000.00
Total	$4,323,743.18
Net increase in capital investments	200,243.18
Total	$4,523,986.36
Increase in reserves for depreciation and depletion	3,048,343.91
Decrease in balance of current assets	$1,475,642.45
Balance of current assets, Dec. 31, 1919	14,376,730.10
Balance of current assets, Dec. 31, 1920	$12,901,087.65

Osceola Consolidated Shows Loss

Copper; Michigan

A report of operations of the Osceola Consolidated Mining Co. for 1920 indicates that 7,465,773 lb. of copper was produced, at a cost of 24.18c. per lb.; 6,297,562 lb., valued at 19c., was on hand Jan. 1, 1920; 7,739,416 lb., valued at 19.97c., was sold at 18.61c. per lb. Earnings follow:

Received for copper delivered (18.61c.)	$1,440,016.58
Cost of copper delivered (20.53c.)	1,588,517.66
Loss on copper delivered (1.92c.)	$148,501.08
Loss by reduction of stock on hand to market	673,393.50
	$821,894.58
Miscellaneous receipts	44,379.26
Net loss	$777,515.32
Dividends paid	96,150.00
	$873,665.32
Capital investments increased	14,053.00
	$887,718.32
Increase in reserve (amortization)	336,827.92
Decrease in balance of current assets	$550,890.40
Balance of current assets, Dec. 31, 1919, adjusted	3,151,257.40
Balance of current assets, Dec. 31, 1920	$2,600,367.00

Allouez Mining Co.

Copper; Michigan

The report of operations of the Allouez Mining Co. for the year 1920 indicates that 2,499,239 lb. of copper was produced, at a cost of 23.9c. per lb.; 2,088,369 lb., valued at 19c., was on hand Jan. 1, 1920; 2,755,598 lb., valued at 20.19c., was delivered during the year. Earnings statement follows:

Received for copper, delivered (18.65c.)	$513,864.44
Cost of copper, delivered (20.75c.)	571,823.59
Loss (2.10c.)	$57,959.15
Loss by reduction of stock on hand to market	199,689.09
Total	$257,648.24
Miscellaneous receipts	8,658.37
Net loss	$248,989.87
Additional taxes for 1917-1918	94,386.67
Total	$343,376.54
Capital investments increased	15,073.25
Total	$358,449.79
Increase in reserves (amortization)	88,315.60
Decrease in balance current assets	$270,134.19
Balance of current assets, Dec. 31, 1919	850,743.93
Balance of current assets, Dec. 31, 1920	$580,609.74

MINING STOCKS

Week Ended April 9, 1921

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Adventure	Boston	....	....	*50		
Ahmeek	Boston	45	43½	45	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	½	1/16	½		
Alloues	Boston	18	16	18	Mar. '19	1.00
Anaconda	New York	38½	35½	36¾	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2½	2½		
Ariz. Com'l	Boston	7½	7½	7½	Oct. '18,	.50
Big Ledge	N. Y. Curb	1/16	¼	1/16		
Bingham Mines	Boston	....	....	8	Sept. '19, Q	.25
Calumet & Arizona	Boston	46	42½	46	Mar. '21, Q	.50
Calumet & Hecla	Boston	224	210	220	June '20, Q	5.00
Canada Copper	N. Y. Curb	....	....	*13		
Centennial	Boston	8	8	8	Dec. '18, SA	1.00
Cerro de Pasco	New York	26½	24½	25¾	Mar. '21, Q	.50
Chile Copper	New York	10¾	9⅞	10⅛		
Chino	New York	22½	19½	21½	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	*22½	*21½	*21½		
Con. Arizona	N. Y. Curb	....	....	1/16	Dec. '18, Q	.05
Con. Copper M.	N. Y. Curb	....	....	1⅛		
Copper Range	Boston	33½	29½	33½	Sept. '20, Q	.50
Crystal Copper (new)	Boston Curb	*32	*28	*28		
Davis-Daly	Boston	5⅛	5½	5⅛	Mar. '20, Q	.25
East Butte	Boston	8	7⅛	7⅛	Dec. '19, A	.50
First National	Boston Curb	*75	*70	*70	Feb. '19, SA	.15
Franklin	Boston	1½	1½	1½		
Gadsden Copper	N. Y. Curb	....	....	*25		
Granby Consol.	New York	17	17	17	May '19, Q	1.25
Greene-Cananea	New York	22¾	20½	21½	Nov. '20, Q	.50
Hancock	Boston	....	....	2½		
Howe Sound	N. Y. Curb	....	....	2½	Jan. '21, Q	.05
Inspiration Consol.	New York	32¼	30½	32¾	Oct. '20, Q	1.00
Iron Cap	Boston Curb	6½	6	6	Sept. '20, K	.25
Isle Royale	Boston	18	17½	18	Sept. '19, SA	.50
Kennecott	New York	18¾	16½	18¾	Dec. '20, Q	.50
Keweenaw	Boston	1 1/16	1	1 1/16		
Lake Copper	Boston	2½	2½	2½		
La Salle	Boston	2	1½	1½		
Magma Chief	N. Y. Curb	....	....	*21		
Magma Copper	N. Y. Curb	19½	18½	19½	Jan. '19, Q	.50
Majestic	Boston Curb	*10	*10	*10		
Mason Valley	Boston	....	....	1¼		
Mass Consolidated	Boston	*95	*80	*85	Nov. '17, Q	1.00
Mayflower-Old Col.	Boston	3¾	3¾	3¾		
Miami Copper	New York	18⅛	17½	18½	Feb. '21, Q	.50
Michigan	Boston	3	3	3		
Mohawk	Boston	48	44½	48	Nov. '20, Q	1.00
Mother Lode (new)	N. Y. Curb	4¾	4⅜	4½		
Nevada Consol.	New York	10½	10	10¾	Sept. '20, Q	.25
New Baltic	Boston Curb	....	....	3		
New Cornelia	Boston	14	13½	14	Aug. '20, K	.25
Nixon Nevada	N. Y. Curb	....	....	*5		
North Butte	Boston	9¾	8½	9¾	Oct. '18, Q	.25
North Lake	Boston	¼	¼	¼		
Ohio Copper	N. Y. Curb	....	....	1/16		
Old Dominion	Boston	....	....	17½	Dec. '18, Q	1.00
Osceola	Boston	24	23	24	June '20, Q	.50
Phelps Dodge	Open Mar.	†160	†130	....	Apr. '21, Q	1.00
Quincy	Boston	37½	37	37	Mar. '20, Q	1.00
Ray Consolidated	New York	12½	11⅜	12⅜	Dec. '20, Q	.25
Ray Hercules	Boston Curb	*35	*35	*35		
St. Mary's Min. Ld.	Boston	30½	30½	30½	June '20, K	2.00
Seneca Copper	Boston	....	....	15⅛		
Shannon	Boston	1½	*90	*90	Nov. '17, Q	.25
Shattuck Arizona	New York	6	5⅛	6	Jan. '20, Q	.25
South Lake	Boston	....	....	1½		
Superior Copper	Boston	....	....	3	Apr. '17,	1.00
Superior & Boston	Boston	1½	1½	1½		
Tenn. C. & C. cfs.	New York	7⅛	7⅛	7⅛	May '18, I	1.00
Tuolumne	Boston	*43	*42	*43	May '13,	.10
United Verde Ex.	Boston Curb	25	21	23½	Feb. '21, Q	.50
Utah Consol.	Boston	3⅛	3⅛	3⅛	Sept. '18,	.25
Utah Copper	New York	49½	46½	48½	Mar. '21, Q	1.00
Utah M. & T.	Boston	1½	1½	1½	Dec. '17,	.30
Victoria	Boston	1½	1½	1½		
Winona	Boston	....	....	*40		
Wolverine	Boston	10⅛	10	10		
NICKEL-COPPER						
Internat. Nickel	New York	15⅛	14⅛	14⅛	Mar. '19,	.50
Internat. Nickel, pf.	New York	...	...	80	Feb. '21, Q	1.50
LEAD						
National Lead	New York	72	71⅛	72	Mar. '21, Q	1.50
National Lead, pfd.	New York	....	....	102½	Mar. '21, Q	1.75
St. Joseph Lead	New York	12⅛	12⅛	12⅛	Mar. '21, Q	.25
Stewart Mining	Boston Curb	....	....	*6	Dec. '15,	.05
ZINC						
Am. Z. L. & S.	New York	8⅛	8⅛	8⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	27	27	27	Nov. '20, Q	1.50
Butte C. & Z.	New York	4⅛	4⅛	4⅛	June '18,	.50
Butte & Superior	New York	11⅛	11	11⅛	Sept. '20,	1.25
Callahan Zn-Ld.	New York	5⅛	4⅞	5	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	136	132	134	Feb. '21, Q	2.00
Success	N. Y. Curb	*3½	*2½	*2½	July '16,	.03
Yellow Pine	Los Angeles	....	....	*150	Sept. '20, Q	.03

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	1⅛	1	1⅛		
Alaska Juneau	New York	1½	1½	1½		
Carson Hill	N. Y. Curb.	....	....	22½		
Cresson Consol. G.	N. Y. Curb	1⅛	1 1/16	1⅛	June '20, Q	$0.10
Dome Extension	Toronto	*60½	*60½	*60½		
Dome Mines	New York	16½	16½	16½	Jan. '21, Q	.25
Golden Cycle	Colo. Sprgs.	†*66	†*64	*65	Dec. '20, Q	.02
Goldfield Consol.	N. Y. Curb	*8	*6	*7	Dec. '19,	.05
Hollinger Consol.	Toronto	7.00	6.90	6.95	Feb. '21, M	.05
Homestake Mining	New York	*60	*59	*59	Sept. '19,	.50
Kirkland Lake	Toronto	*49½	*49½	*49½		
Lake Shore	Toronto	1.16	1.12	1.16	Jan. '21, K	.02
McIntyre-Porcupine	Toronto	1.98	1.91	1.91	Jan. '21, K	.05
Porcupine Crown	Toronto	*21	*20	*20½	July '17,	.03
Portland	Colo. Sprgs.	*45	*45	*45	Oct. '20, Q	.01
Reorgan. Booth	N. Y. Curb	*5	*3	*4½	May '19,	.05
Silver Pick	N. Y. Curb	*7	*5	*5		
Teck Hughes	Toronto	*12	*11½	*11½		
Tom Reed	Los Angeles	1.16	1.10	1.14	Dec. '19,	.02
United Eastern	N. Y. Curb	2¼	2⅛	2 1/16	Jan. '21, Q	.15
Vindicator Consol.	Colo. Sprgs.	†*20	†*17½	*1⅞	Jan. '20 Q	.01
West Dome Consol.	Toronto	*6½	*6½	*6½		
White Caps Mining	N. Y. Curb	*8	*6	*7		
Yukon Gold	N. Y. Curb	¼	¼	¼	June '18,	.02½
SILVER						
Arizona Silver	Boston Curb	*25	*20	*24	Apr. '20, M	.03
Batopilas Mining	New York	⅜	⅜	⅜	Dec. '07, I	.12½
Beaver Consol.	Toronto	*35½	*35½	*35½	May '20, K	.03
Coniagas	Toronto	1.90	1.90	1.90	Nov. '20, Q	.12½
Crown Reserve	Toronto	....	....	*16	Jan. '17,	.05
Kerr Lake	Boston	....	....	2¼	Jan. '21, Q	.12½
La Rose	Toronto	*23	*21	*23	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*20	*17	*17	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.00	1.00	1.00	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	7⅛	6½	7	Jan. '21, QX	.50
Ontario Silver	New York	4½	4	4	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	1½	1⅜	1½	Jan. '12,	.10
Peterson Lake	Toronto	*6½	*6½	*6½	Jan. '17,	.01½
Temiskaming	Toronto	*24	*24	*24	Jan. '20, K	.04
Trethewey	Toronto	*13½	*13	*13	Jan. '19,	.05
GOLD AND SILVER						
Atlanta	N. Y. Curb	*2	*1	*1		
Barnes-King	Butte	‡....	....	1.10	Aug. '20, Q	.05
Boston & Montana	N. Y. Curb	*66	*61	*66		
Cashboy	N. Y. Curb	*7	*5½	*6		
El Salvador	N. Y. Curb	1/16	¼	¼		
Jim Butler	N. Y. Curb	*14	*10	*11	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*9	*5½	*6	June '16,	.05
Louisiana Con.	N. Y. Curb	....	....	¼		
MacNamara M.& M.	N. Y. Curb	*15	*13	*14	May '10,	.02½
N. Y. Hond. Rosar.	Open Mar.	†10½	†9	....	Jan. '21, Q	.30
Tonopah-Belmont	N. Y. Curb	1⅛	1 1/16	1⅛	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	1⅛	1	1⅛		
Tonopah-Extension	N. Y. Curb	1 1/16	1⅛	1 1/16	Apr. '21, Q	.05
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1⅛	Oct. '20, SA	.05
West End Consol.	N. Y. Curb	1 1/16	1 1/16	1	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N.Y. Curb	*12	*10	*11	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	1.05	1.00	1.05	Dec. '20,	.15
Chief Consolidated	Boston Curb	....	....	2½	Feb. '21, Q	.05
Consol. M. & S.	Montreal	....	....	16	Oct. '20, Q	.62½
Daly Mining	Salt Lake	....	....	2.50	July '20, Q	.10
Daly-West	Boston	....	....	3	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	....	....	2½	Dec. '20, K	.25
Electric Point	Spokane	*7	*7	*7	May '20, SA	.03
Federal M. & S.	New York	....	....	6½	Jan. '09,	1.50
Federal M. & S., pfd.	New York	....	....	23	Mar. '21, Q	1.00
Florence Silver	Spokane	*16	*16	*16	Apr. '19,	.01½
Grand Central	Salt Lake	....	....	*37½	June '20, K	.03
Hecla Mining	N. Y. Curb	3⅛	3⅛	3⅛	Mar. '21, Q	.15
Iron Blossom	N. Y. Curb	15	15	*15	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	....	....	3.00	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*7	*5	*6½		
Prince Consol.	N. Y. Curb	1/16	¼	¼	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*6	*5	*6	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*8	*7	*7½		
South Hecla	Salt Lake	*95	*95	*95	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	1/16	⅛	1/16	Oct. '17,	.05
Tamarack-Custer	Spokane	2.00	1.90	1.90	Jan. '21, K	.04
Tintic Standard	Salt Lake	2.62½	2.27½	2.55	June '20, Q	.10
Utah Apex	Boston	2½	2	2	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*4	*3	*3½	Nov. '17,	.01
QUICKSILVER						
New Idria	Boston	....	....	*95	Jan. '19,	.25
VANADIUM						
Vanadium Corp.	New York	31	28½	29½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	....	....	73	Jan. '21, QX	3.50
Asbestos Corp., pfd.	Montreal	....	....	89½	Jan. '21, QX	3.75
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	38½	36	37½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	74½	69⅜	74	Mar. '21, Q	1.75
Am. Sm. pf. A	New York	63	63	63	Apr. '21, Q	1.50
U. S. Sm. R. & M.	New York	29½	26	29	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	Boston	42	40½	40½	Jan. '21, Q	.87½

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.